AVIATION AND AERONAUTICAL ENGINEERING

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Winter Sport at Palm Beach

FEBRUARY 1st 1917

SPECIAL FEATURES

THE TREND OF DESIGN IN FOREIGN AERONAUTIC ENGINES
PROGRESS OF THE AVIATION SECTION
COURSE IN AERODYNAMICS AND AIRPLANE DESIGN
AERONAUTICS FOR 1917
AERONAUTICAL MANUFACTURERS' ASSOCIATION FORMED
THE PAN-AMERICAN AERONAUTIC EXPOSITION

PRICE Ten Cents

PUBLISHED SEMI-MONTHLY BY
THE GARDNER, MOFFAT CO., Inc.
120 W. 32nd ST. NEW YORK

V 2 Feb-July 1917

A Word About The Standard Aero Corporation

AIR UNIVERSITY LIBRARY MAXWELL FIELD, ALABAMA

One of the wonderful developments of the aeronautical industry—that in truth is the *Standard Aero Corporation.*

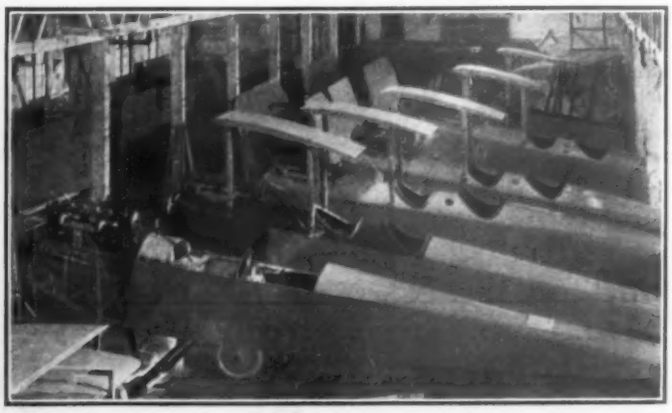
Housed in one of the largest, busiest airplane factories in the world, the *Standard Aero Corporation* has attained a new standard of efficiency in aeronautics.

Mr. Charles H. Day, chief engineer and designer, is among the notable figures in American aeronautical engineering. Around him have been gathered the most efficient men that money can secure—from the heads of departments to the men who do the actual construction work.

Not to see how rapidly and profitably but how well its work can be done,—that is the spirit which actuates the entire organization.

The remarkable record of *Standard Airplanes* speaks for the result. Generous support from the government and an enormous volume of business have been the rewards.

And still the same unremitting effort goes on to make each Standard the best airplane that can be made.



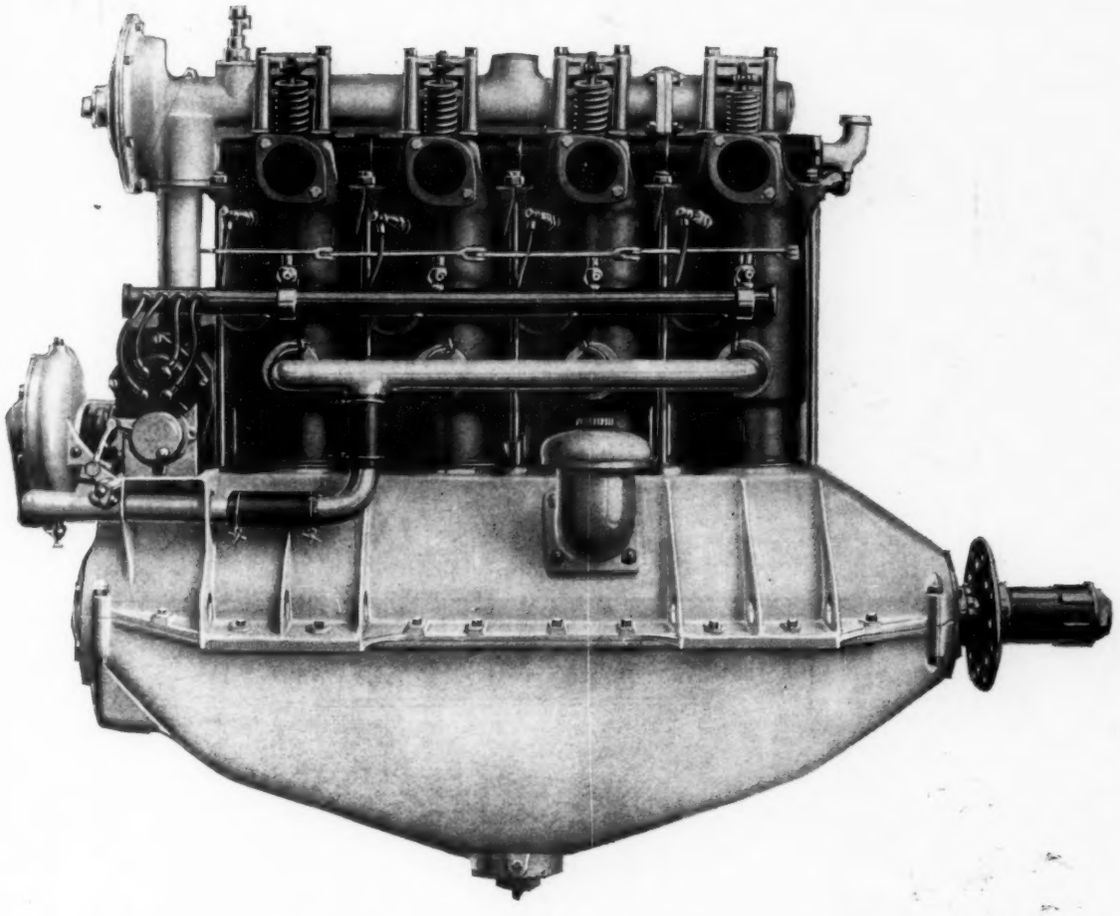
Section of Fuselage Department, Standard Aero Corporation.

Standard Aero Corporation of New York

Factory - Plainfield, N. J.

Executive Offices, Woolworth Bldg., N. Y.

HALL-SCOTT



The Hall-Scott, Type A-7a, 100 H.P., Four Cylinder, Airplane Engine, is offered as the most ideal equipment the market affords, for Army and Navy TRAINING and LIGHT SCOUTING Machines.

The design of this engine provides for sturdy construction, coupled with light weight. With proper use, 100 hours of actual flying service may be obtained without overhauling.

Governments that have knowledge of excessive upkeep costs of lighter type, short duration engines, of complicated design and delicate mechanism, will be interested in this equipment.

Total weight, complete and ready for service, but without lubricating oil, 400 lbs.	
Weight per H.P. (Based on actual H.P. development, at 1,300 R.P.M.)	*3.50 "*
Consumption gasoline in lbs. per H.P. hour,	*.557*
" lubricating oil " " "	*.045*

The Perfect Air Starter, used in connection with this engine, will afford ideal starting service. Added weight of the starting equipment, complete, 56 lbs.

Hall-Scott Motor Car Co., Inc.
General Offices
Crocker Bldg., San Francisco, Calif.

F. P. Whitaker
EASTERN REPRESENTATIVE
165 Broadway, New York City

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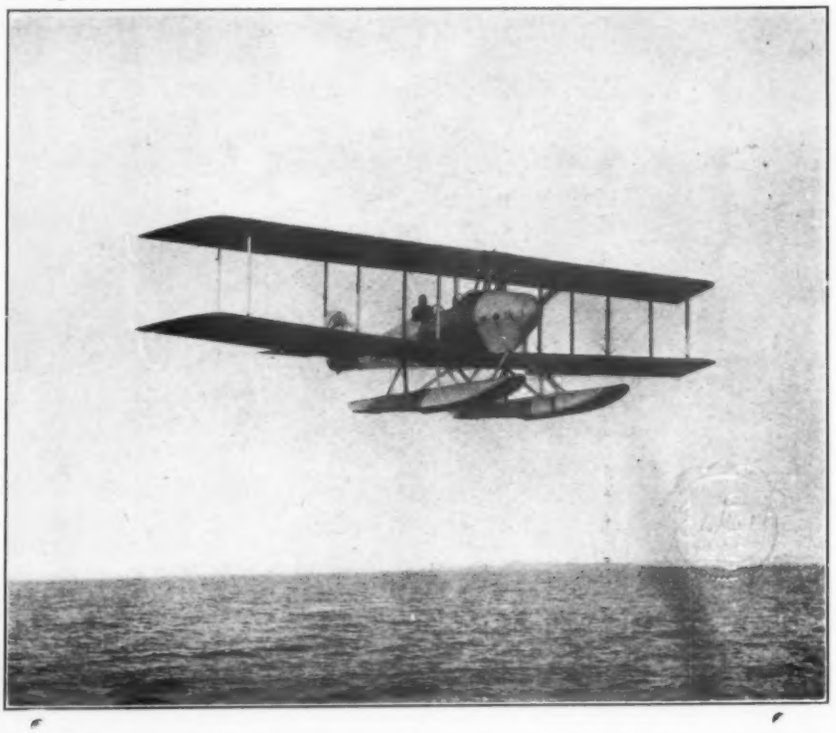
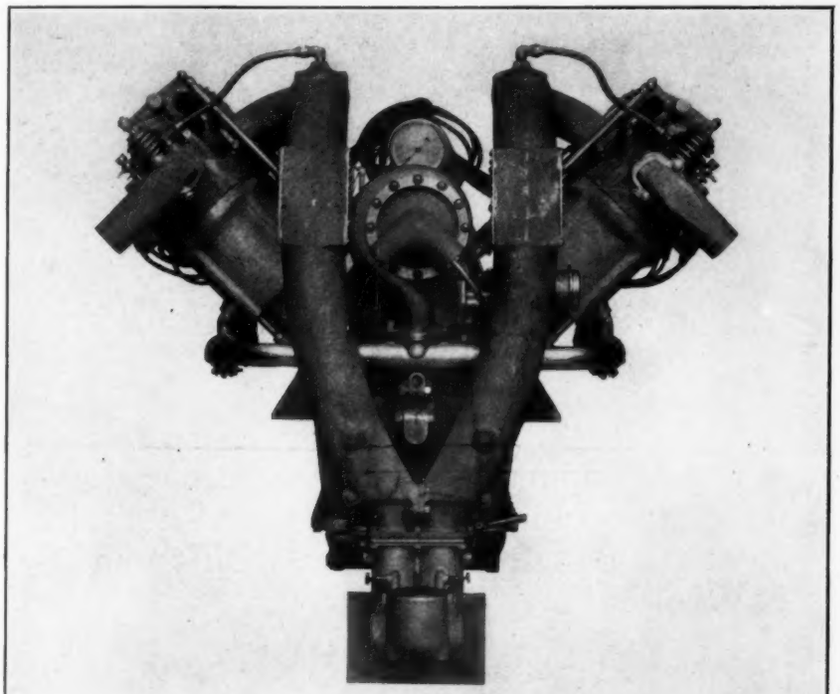


The Sturtevant Seaplane

After one year of development----the premier steel airplane of the world.

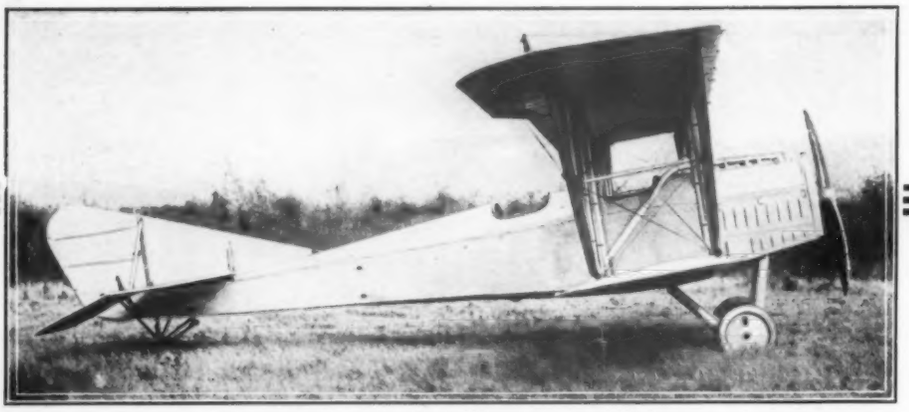
Sturtevant
(REG. U. S. PAT. OFF.)
AEROPLANE COMPANY
Jamaica Plain, Boston, Mass.



The Sturtevant Aluminum Engine

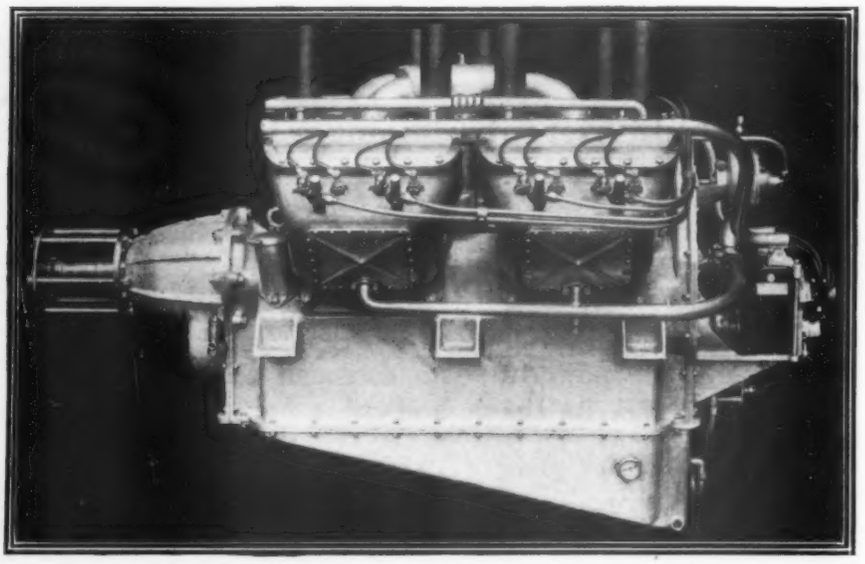
Light and powerful—its thorough reliability apparent in its simple and substantial details.

Sturtevant
REG. U. S. PAT. OFF.
B. F. STURTEVANT COMPANY
Hyde Park, Boston, Massachusetts.



THOMAS D-5 RECONNAISSANCE TYPE

A new **Thomas type** designed especially for military purposes, combining unusual **strength** of **construction, stability** and **controllability.**



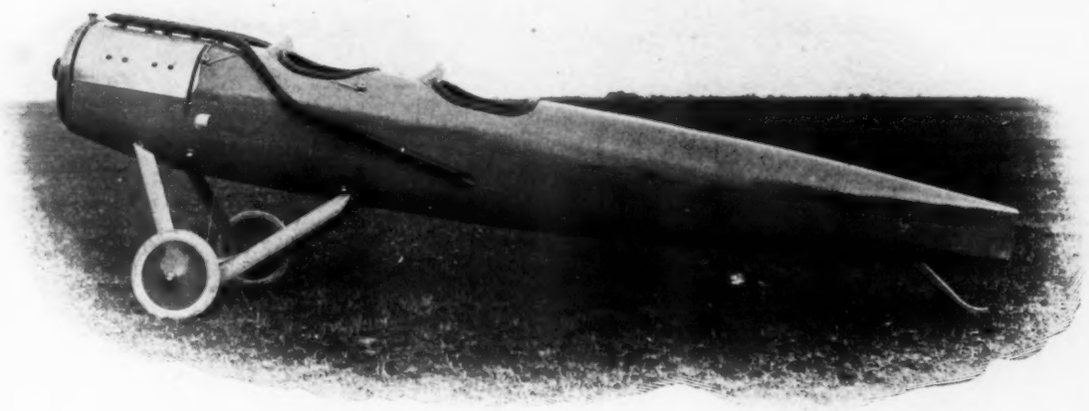
THOMAS 135 H. P. AEROMOTOR

With the increased facilities afforded by a **new concrete steel factory** and **additional manufacturing equipment,** we shall be able to meet the ever increasing demand for **Thomas Aeromotors.**

Contractors to U. S. Army and Navy

THOMAS-MORSE AIRCRAFT CORPORATION

ITHACA, N. Y., U. S. A.



LAMINATED WOOD FUSELAGE
CLEAN CUT BODY
MINIMUM OF RESISTANCE

L-W-F ENGINEERING COMPANY

Aeromarine Engine and Sales Co.

DESIGNERS *and* CONTRACTORS *for*

Highest Grade Aircraft

Announcing Exhibit, Main Floor

Pan-American Aeronautic Exposition

Grand Central Palace
NEW YORK CITY

February 8 to 15

NEW YORK OFFICE
ROOM 1511 TIMES BUILDING
Tel. Bryant 6147

The Goodyear Contribution

No exhibit at the Aeronautical Show can be regarded as a mere display of merchandise.

The smallest piece of minor equipment, every unit of machinery, as well as each aeroplane and balloon are all sublime testimony to the dauntless spirit of man. All are steps toward perfection in the conquest of the element so long unconquerable.

To the manufacturer as well as to the daring men and women who are advancing that conquest a shock absorber has as deep an interest as a life-guarding tire.

A fragment of newly developed balloon fabric is as vital as a new type of kite balloon which may serve as precious eyes for our defending armies.

Every exhibit is evidence of the contributions manufacturers are making to a far greater thing than mere technical development.

It is in this spirit that the Goodyear equipment is shown, for it is the spirit which caused its development.

When record breaking flights are made with aeroplanes Goodyear-equipped, such as those of Victor Carlstrom and Miss Ruth Law, the Goodyear organization feels well rewarded for its labor.

Not merely because its products have been notably endorsed, but rather because the Goodyear effort has been proved worth while.

Not only toward aviation is the Goodyear energy directed, but also toward that instrument of aerial mastery which the great war is justifying anew, the balloon.

For the dirigible and the kite balloon have truly come into their own, not as instruments of destruction, but as eyes for army and navy.

Since the amazing revelations in Europe the Goodyear activity which produced the prize-winner in the last great International Balloon Race before the war, has been intensified.

One of the latest results is the new kite balloon—80 ft. long and of 25,000 cu. ft. capacity—which represents a substantial advance in this type of construction.

It will not shift, veer or yaw, even in a stiff gale.

The research and engineering skill which produced it, have also produced spherical, and dirigible balloons of any size and every type, aeroplane tires, bumpers, rims and other aeronautical supplies — all shown at this year's exhibit.

The Goodyear Tire & Rubber Company, Akron, Ohio

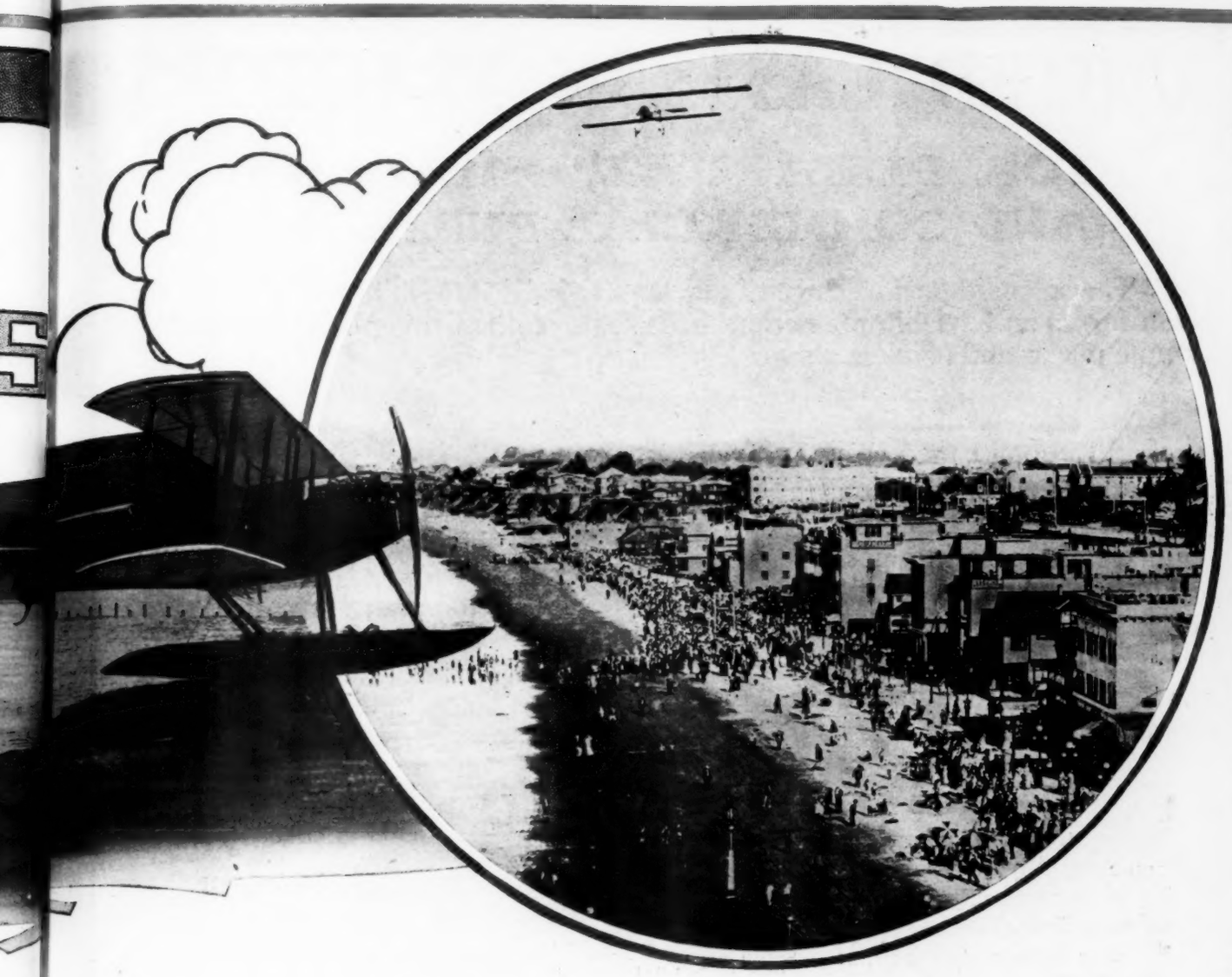
GOODYEAR

AKRON

SKF
BALL BEARINGS

SOME
SKF Users

Aeromarine Plane & Motor Co.
Curtiss Motor Co.
Dusenberg Motor Company
Hall Scott Company
Knox Motors Company
Loew-Victor Engine Company
Sperry Gyroscope Co.
Sterling Engine Co.
The B. F. Sturtevant Company
Van Blerck Motor Company



THREE miles high in the air—through swift wind—

piercing smoke and fog—fast high-powered aeroplanes fly at tremendous speed. Think of the constant bombardment of explosions on the pistons—the warping and weaving of the planes—the strain on the bearings—do you wonder why the leading aeroplane manufacturers use the most efficient ball bearings at the vital power points? Can you afford to take a chance with binding strains or the sticking of bearings? If they're S K F you can soar with confidence. You can have the satisfaction of knowing that your aeroplane motor is equipped with the safest and most reliable ball bearings that money will buy. Don't trifle with price when safety and dependability are at stake. Demand S K F Self-Aligning Ball Bearings—know the feeling of security on two rows of Swedish Crucible Steel Balls.

Double Row of Balls

S K F Ball Bearings have a double row of balls. This means also a minimum load per ball. The balls are arranged in staggered relation, giving even distribution of load.

Swedish Steel

It is uniformly hard throughout, highly tempered and accurately finished. Balls and races are made of Swedish steel. This steel is unequalled for toughness and durability.

SKF BALL BEARING CO.

HARTFORD, CONN.

S K F
BALL BEARINGS
USED THE WORLD OVER

Self-Alignment

S K F Ball Bearings adapt themselves to any shaft deflection or spring. A very necessary feature for any bearing.

Ball Retainer in One Piece

The retainer cage is made in one piece, and will not jam balls, disarrange spacing, or make noise. The retainer is open at the sides permitting of easy inspection and cleaning and insuring positive circulation of the lubricant.

UNITED EASTERN TRACTORS

FOR PLEASURE, MILITARY AND COMMERCIAL PURPOSES

The splendid performance of our latest Model A-M Tractor Biplane has won for us an enviable reputation through its faultless design, perfect control, ample power and efficient service.

Great care has been exercised to obtain the most advantageous combination of speed, safety climbing and weight carrying possible in a machine of this class. We have exceeded the usual requirements for strength so that we have a high factor of safety.

Military tractor biplanes, monoplanes, hydro-aeroplanes, flying boats or machines of special design built from our specifications or those supplied us, at a price worthy of consideration.

United Eastern Biplane flying over U. S. Gov't hangars Mineola, L. I.

United Eastern Aeroplanes have been submitted to rigorous and exhaustive tests, showing the very highest flying efficiency. Their design and construction are the result of seven years of successful aeronautical engineering and construction experience, which places them to-day among the best in the world.

We are exceptionally prepared to execute orders immediately regardless of size or quantity desired.

Specifications and full particulars upon request.

Eastern School of Aviation conducted in connection at Sheepshead Bay Speedway, Brooklyn, N. Y.

Three-quarter rear view of United Eastern Tractor Biplane

Side View.—Model A.-M., United Eastern Tractor Biplane

UNITED EASTERN AEROPLANE CORPORATION

Telephone 2982 Bushwick

1251 - 1257 DEKALB AVENUE
BROOKLYN, New York
Cable Address "EASTAERO" NEW YORK

Demonstrations by Appointment

Exhibiting at the PAN-AMERICAN AERONAUTIC EXPOSITION February 8 to 15

What can Delco *do for Aviation?*

Let's discuss that at the Exposition. There will be a Delco Exhibit there for that very purpose. Delco engineers and investigators will be in charge. You will find them ready to take up your problems with you—eager to learn in what way they can help you. Personal acquaintanceship, we believe, will be as much to your advantage as our own.

Delco has faith in Aviation—A vision of big achievements and practical applications—not in the dim and distant future, but close at hand. And Delco faith is backed by Delco willingness to play its part—to place its resources, its knowledge, at the service of those who are pioneering their way through the problems that must be solved.

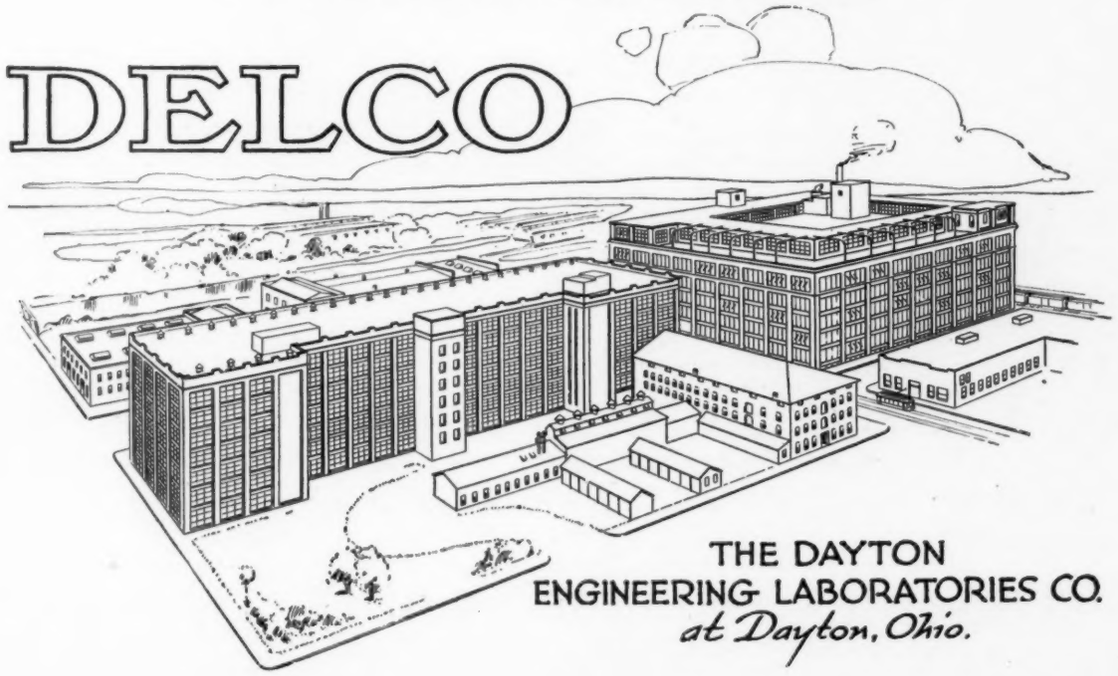
Delco brings much to Aviation. Facilities for research? Yes. Delco laboratories stand second to none in aiding Science—giving a free hand, full sway, and unlimited opportunity for expert experiment.

Ability to manufacture? Yes. From a barn-loft laboratory four years ago, working on an unknown product, to a wonder-plant in 1917 with half a million automobiles, Delco equipped, is evidence of Delco ability and output.

But what is even more important still—the Spirit—the Ideal, too, is there—*to serve first and, only after serving, to reap the reward that service warrants.*

Delco invites you—offers its co-operation. Delco has no special propaganda to promote—no theories to establish. We're at this exposition just as you are—to see the progress aviation is making—to meet the men on whom its future rests—to show what we ourselves are doing—to join in every move that helps its growth.

Meet us at the Grand Central Palace. We think you'll find us worth a visit and know that we have much to learn from you



THE DAYTON ENGINEERING LABORATORIES CO.
at Dayton, Ohio.

The solution of the greatest problem in Aviation.

—— At the Show ——

The Martin Aerodynamic Stabilizer

SAFETY FOR YOUR AEROPLANE AND FREEDOM FROM WRIGHT PATENT INFRINGEMENT.

The Martin Aerodynamic Stabilizer is not an experiment, but has been submitted in actual flight to the severest tests.

It is built entirely of Aerometal, a light, strong, noncorrosible metal; is simple, having but three movable parts; and cannot get out of order.

It weighs less, and creates less head resistance than the standard controls it replaces.

It relieves the operator of all concern for the lateral balance of the aeroplane, and takes its own definite bank on turns.

The only way an aeroplane equipped with Martin Aerodynamic Stabilizers can be made to roll is by the operator steering alternately from one side to the other.

The structural and operative features embodied in the Martin Aerodynamic Stabilizer have been defined by the United States Courts as those which do not infringe the Wright Patent.

The device is fully protected by patents pending in all countries, and license is furnished with each installation.

In November, 1916, an American Army Aeroplane equipped solely with this device made the first flight in the history of aviation, without the operator having available either warping or other lateral control.

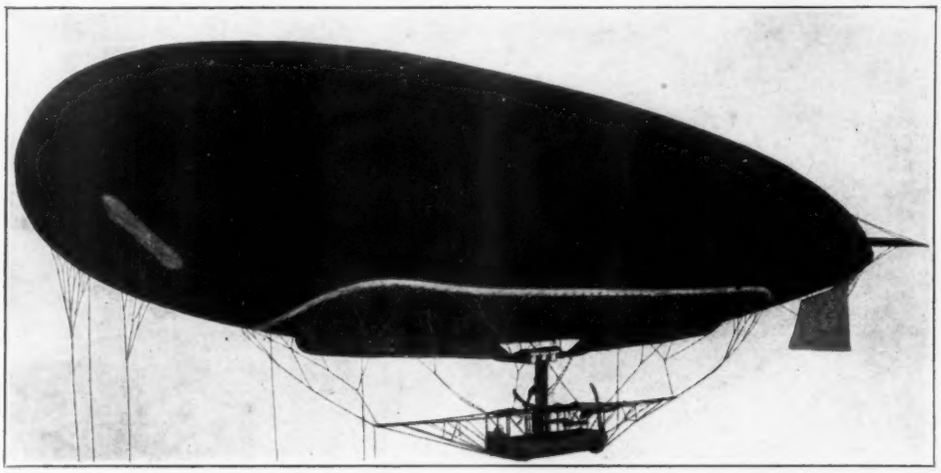
The flights embraced spirals, dives, figures of eight, landings with and across the wind and a cross country flight of 150 miles with passenger.

NOTE: The Aerodynamic Stabilizer is the invention of Capt. Jas. V. Martin, the American Master Mariner, and pioneer Aviator, who originated, built and demonstrated the first successful Tractor Biplane in America. He has no connection with the Glenn L. Martin Company of Los Angeles, or the Wright-Martin Aircraft Corporation.

See advertisement in the official show Program relative to the bearing of the Martin Aerodynamic Stabilizer on the Wright Patent Controversy.

THE MARTIN AERODYNAMIC STABILIZER

Elyria, Ohio, U. S. A.



NON-RIGID DIRIGIBLE AS SUPPLIED U. S. NAVY

The Connecticut Aircraft Company

New Haven, Conn. U. S A.

CONTRACTORS TO THE UNITED STATES ARMY AND NAVY

Manufacturers of

Dirigibles Non-Rigid, Semi-Rigid and Rigid (Zeppelin) Types

Military and Naval Observation Balloons

Scout and Fuselage Type Dirigibles

Spherical Balloons and Gas Containers

MILITARY OBSERVATION KITE BALLOON AS BUILT FOR U. S. ARMY

Visit Our Exhibit at the Aeronautical Exposition

Factory and Executive Office
NEW HAVEN, CONN.

Specifications and Quotations On Request

NEW YORK OFFICE
303 Fifth Avenue

THE NEW WATER SPORT OF THE SUPERMAN

Instruction
in a General Aeroplane Co's Verville Type Flying Boat will convert the ardent speed motor boat enthusiast to the virile man making sport of flying

"PREPAREDNESS"

Office —
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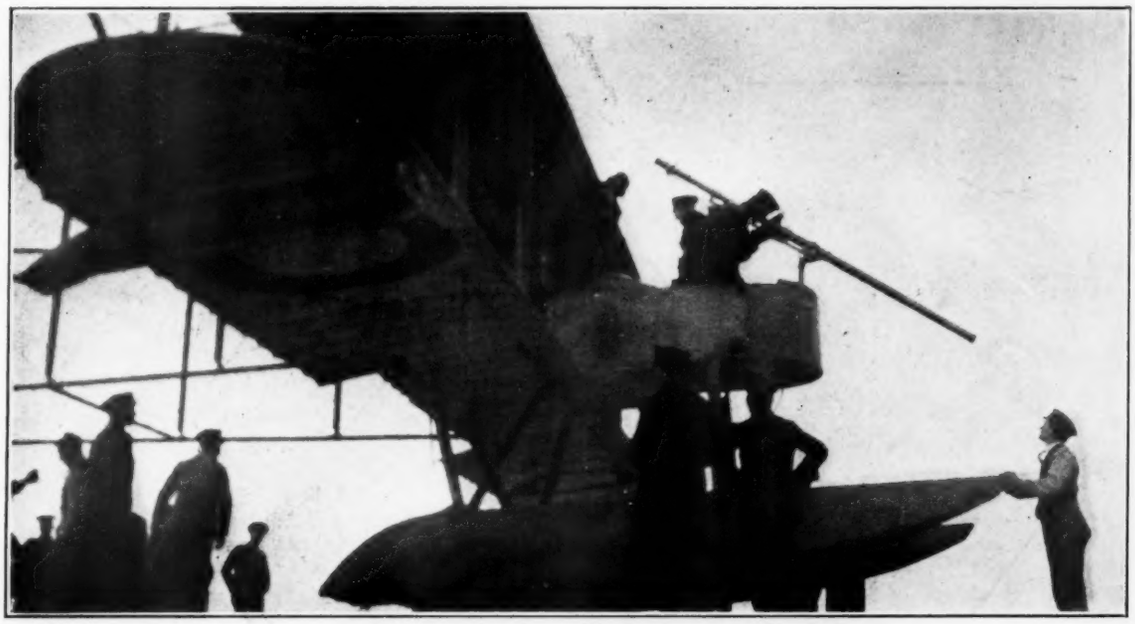
GENERAL AEROPLANE CO.
Detroit U.S.A

Hangars
Old Detroit Motor Boat Site

Photographs Taken "Somewhere" in the War Zone



THE GENERAL ORDNANCE COMPANY

Non-Recoil Gun

Snapped in Europe December 1916

For Description See Page 52 of this Issue

Hundreds Being Used Abroad in the War of Today on

AIRPLANES, MOTOR BOATS, AUTOMOBILES, ETC.

Sole Manufacturers (Davis Patents)

THE GENERAL ORDNANCE COMPANY

DERBY, CONN., U. S. A.

An Aeroplane Wheel Designed to Absorb Shocks in Landing

is being built by THE ACKERMAN WHEEL COMPANY, Cleveland, Ohio. A special alloy steel specially treated is used in the spokes. The spokes are built on a curve and are hung on a hinge at the rim, allowing free movement of all spokes as the load thereon increases or decreases.

Results of tests conducted with these wheels show that the hub can leave the center of the wheel under a maximum load or thrust and return to center without the spokes taking a set. *No other wheel in use will meet such conditions.*

The lateral strength of this wheel exceeds by a wide margin that of the ordinary wheel and the ability of the ACKERMAN WHEELS to absorb shocks should quickly bring them into favor with manufacturers and aviators.

The spokes being hung at the rim permits replacement of spokes very quickly and without removing tire from rim.

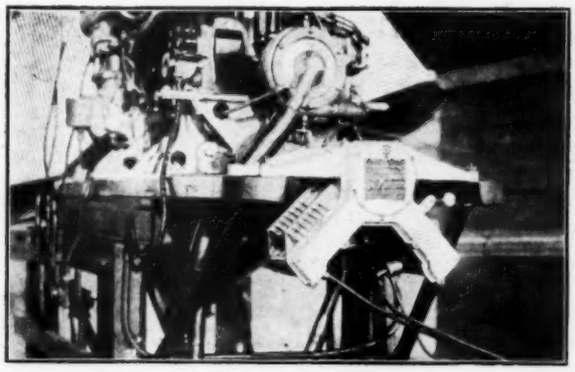
These wheels can be built according to weight of machine or load from 500 pounds up.

For further information address

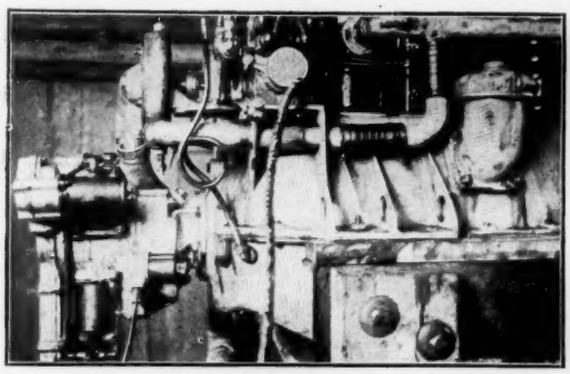
The ACKERMAN WHEEL COMPANY

Rockefeller Bldg. - Cleveland, O.

THE PERFECT STARTER



Model C starter mounted on engine



Model D starter mounted on engine

It is an air motor for starting, and a compressor to store air for its own energy in starting.

It replenishes its energy for starting in less time than any other starting system in existence.

It is entirely self-contained.

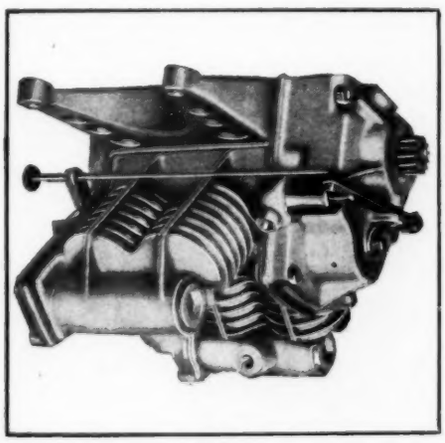
It couples direct to the end of crankshaft of motor.

It needs no alteration in motor or other gear reduction for attachment.

It has ample power and speed for magneto starting.

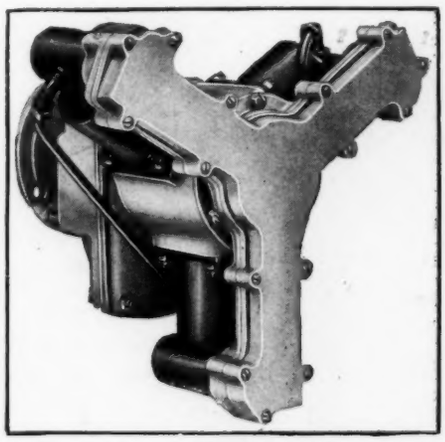
Model C—For starting engines up to 250 H.P. The device weighs 39 pounds, and complete with every fitting for single engine installation 70 pounds; for twin engines 110 pounds.

Model D—For starting engines up to 150 H.P. The device weighs 34 pounds, and complete with every fitting for single engine installation 58 pounds; for twin engines 96 pounds.



Model C

The Perfect Starter is of the compressed air type, convertible to either an air motor for starting, or an air compressor for storing air into a specially constructed tank. A transmission is combined in the construction of the device taking care of all changes of operation. It is entirely idle except when in action as a starter or a pump, and when pumping releases automatically at maximum pressure. It will average 15 separate starts on a volume of air which is pumped back in less than 30 seconds.



Model D

The Perfect Starter has been tested and approved by the United States, British, Dutch, Norwegian and Swedish Governments

THE MOTOR-COMPRESSOR COMPANY, Newark, N. J., U. S. A.

Our space at the Aeronautic Exposition is No. 238, on the Second Floor at the foot of the main stairway.

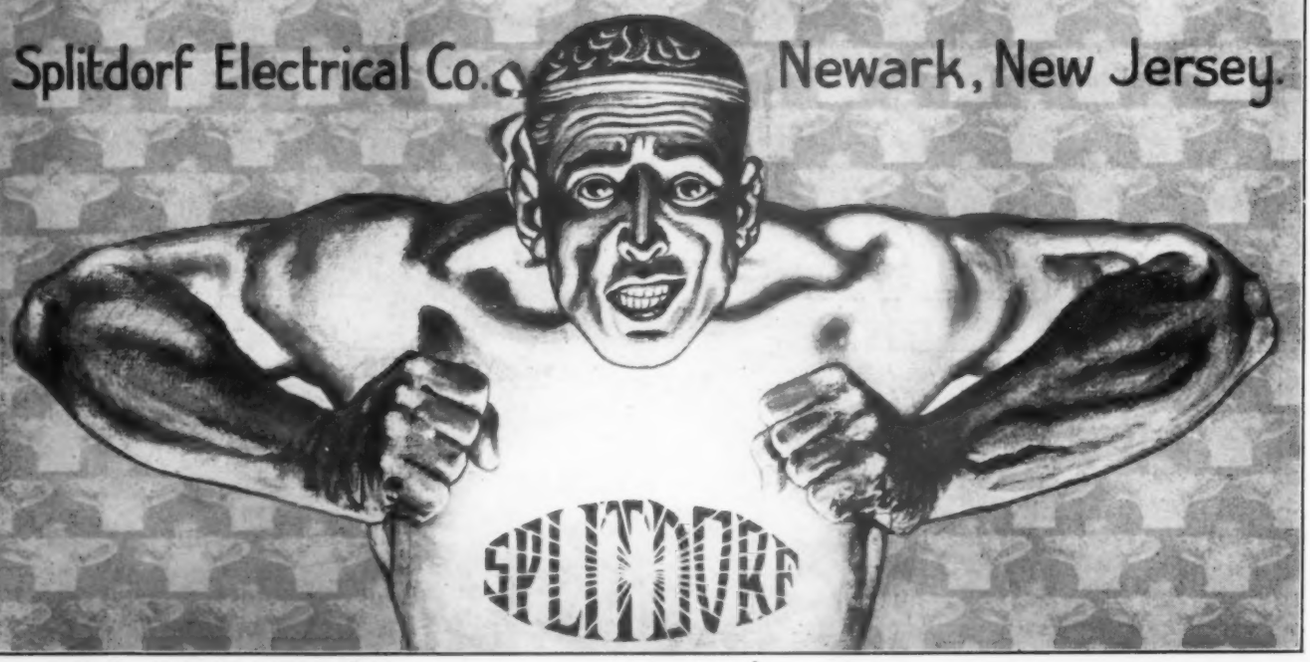
OUR display at the National Aeronautical Show best reflects the conscientious manufacture of our Giant line of Ignition Devices.

Our wide range of equipment is an assurance of the most comprehensive ignition service available at our branch houses throughout the country.

DIXIE 20TH CENTURY MAGNETO

The Plug with the Green Jacket

Splitdorf Electrical Co. Newark, New Jersey.



Trailmobile
TRADE MARK REG. U.S. PAT. OFF.
M'F'D. BY
THE SECHLER & COMPANY
PATENTS APPLIED FOR CINCINNATI, O. U.S.A.

MADE BY

THE SECHLER & COMPANY

CINCINNATI, OHIO

The Trailmobile is on Exhibition at 1876 Broadway, New York, by The Eastern Trailmobile Sales Company

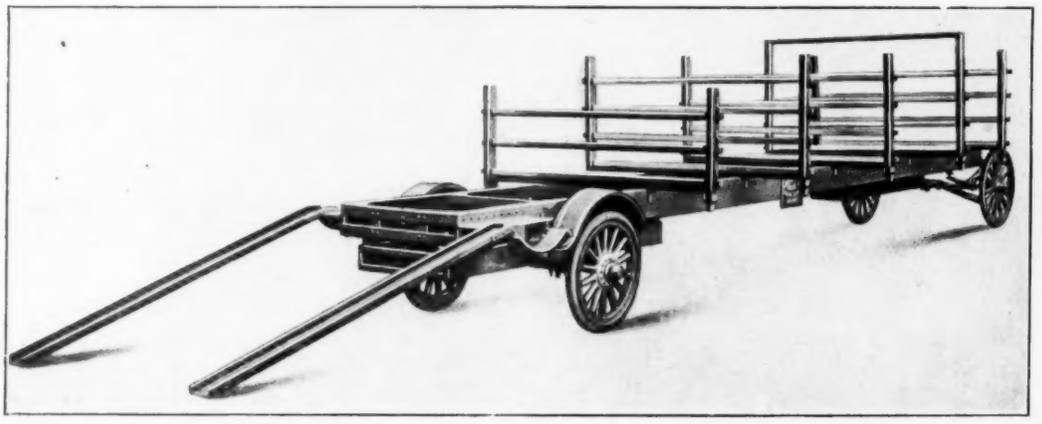
Used by the U. S. Army and National Guard

Successfully used in the awful road conditions of Mexico

Especially serviceable to carry hangar supplies and equipment for aviation work

Free Booklet "TRAILING VILLA"

THE TRAILMOBILE ARMY TRANSPORT



THE TRAILMOBILE CARRIER

ADOPTED BY
THE SIGNAL CORPS, U. S. A.
AVIATION SECTION

GUARANTEED: To carry airplane without disassembling except as to wings.
To carry wings without injury.
To be equally useful in city, field or desert.

First Pan-American

AERONAUTIC EXPOSITION

HELD UNDER THE AUSPICES OF

THE AERO CLUB OF AMERICA
THE PAN-AMERICAN AERONAUTIC FEDERATION
THE AMERICAN SOCIETY OF AERONAUTIC ENGINEERS

THE EXPOSITION WILL COMPRISE THE MOST UP-TO-DATE PRODUCTS OF THE AMERICAN AERONAUTIC INDUSTRY AND INCLUDES:

THE ARMY AND NAVY AERONAUTIC EXHIBITS.
NATIONAL GUARD AND NAVAL MILITIA SECTIONS.
NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS' EXHIBIT.
AERO CLUB OF AMERICA AND PAN-AMERICAN AERONAUTIC FEDERATION SALONS.
AERO COAST PATROL EXHIBIT.
AMERICAN SOCIETY OF AERONAUTIC ENGINEERS (Standardizing section).
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WEATHER BUREAU EXHIBIT.
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PAN-AMERICAN UNION EXHIBIT OF RELIEF MAPS, ETC.
COAST GUARD EXHIBIT.
POST OFFICE EXHIBIT OF MAPS AND LOCATIONS OF 200 PROPOSED AERIAL MAIL ROUTES.
SMITHSONIAN INSTITUTION EXHIBIT.
DIRIGIBLE BALLOONS.
BALLOONS.
MOTION PICTURE HALL.

GRAND CENTRAL PALACE

NEW YORK CITY

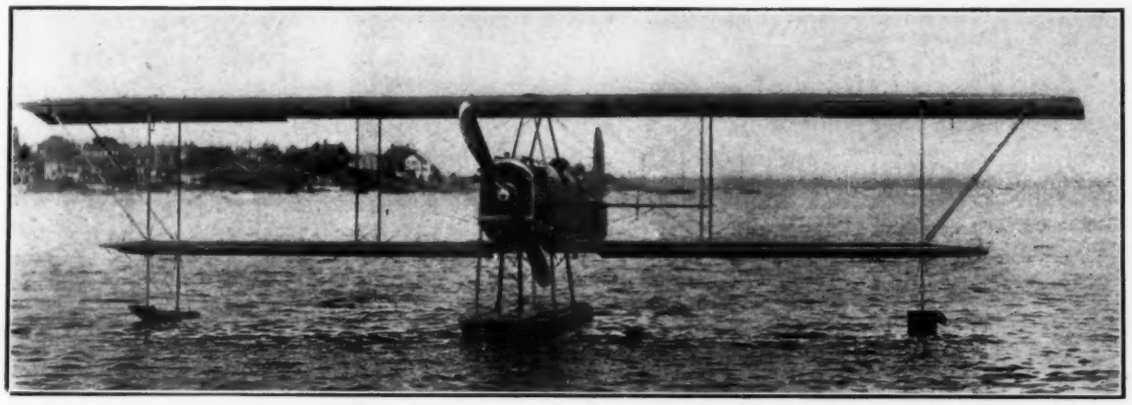
FEBRUARY 8 to 15, 1917

Address all Communications to HOWARD E. COFFIN, Chairman

PAN-AMERICAN AERONAUTIC EXPOSITION, 297 Madison Avenue, New York

Telephone Murray Hill, 71-72

ADMISSION 50 CENTS



BURGESS TRAINING HYDROAIRPLANE

Among the many models of Airplanes, Seaplanes and Flying Boats produced by this company the new "U" type Hydroairplane meets a very pressing need,—an efficient, well balanced flying machine of conventional type, and low power for militia training purposes.

The Massachusetts Naval Militia has the first one now in service.

Standard Deperdussin control in duplicate; Curtiss OXX-2 motor; simple float; light, sturdy construction; large speed range (forty to sixty-eight miles per hour); are characteristics necessary to the hard service required for training purposes.

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FEBRUARY 1, 1917

AVIATION
AND
AERONAUTICAL ENGINEERING

VOL. II. NO. 1

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Vol. II | February 1, 1917 | No. 1

ALMOST important step was taken by the American aeronautical industry in the formation of the temporary association of airplane manufacturers on January 24. The organization of this association resulted from a desire on the part of the manufacturers, who are to be represented in large space at the Pan-American Aeronautical Exposition, to talk over and settle once for all some of the problems presented by the organization of the Exposition. The only way in which these problems could be solved was by those financially interested in the industry getting together face to face and talking them over until they reached a definite conclusion.

The industry needed a temporary association of manufacturers at once—before the exposition—or else the success of the exposition would have been menaced. But the effects of the formation of the association—which will undoubtedly be succeeded by a permanent organization before this issue reaches our subscribers—will be much more far reaching than merely settling the difficulties that threatened the complete success of this year's show. It will mean a common meeting ground of manufacturers for commercial purposes, which will permit the settling of all questions that may arise in the industry at any time easily and quickly.

There is so much work that is obviously to be done at once that considerations of space prevent the presentation of more than the briefest outline. Standardization will be the keynote of the progress of the industry this year. There are problems of law and of patents to be solved. Much damage has already been done to the industry by companies which entered the business of aviation in order to drive their stock into the air and not in order to send planes there. Over such promotions the manufacturers' association can exercise a beneficial scrutiny. There is business enough for all. Claims of impossible performances and insincere promises of delivery of machines have been all too common. The formation of the association marks an epoch-making date in the history of the industry.

An American Aeronautical Exposition on Paper

This issue of AVIATION AND AERONAUTICAL ENGINEERING is the Exposition number and comes at the time of the Pan-American Aeronautical Exposition in the Grand Central Palace. Every prospect is for the extraordinary success of the Exposition. At the same time several companies which occupy important positions in the industry have found it impossible for one reason or another to exhibit.

An effort has been made to include in this issue a complete survey of the entire industry of the United States. Most of the data has been gathered from the manufacturers themselves and the accuracy of the claims included is a matter for which AVIATION AND AERONAUTICAL ENGINEERING cannot assume responsibility. However, nineteen companies, building forty-three models of airplanes, and seventeen companies, building thirty-two models of engines, not to speak of over forty companies making accessories, which are included in this issue, serve to give some indication of the magnitude of the aeronautical industry.

All the combined talent of these companies, working with the new spirit of co-operation which will be inaugurated by the Manufacturers' Association and the S. A. E., insures rapid progress and sound growth in the industry.

Brigadier-General George O. Squier

The nomination of Lieut. Col. George O. Squier as Chief Signal Officer of the Army, with the rank of Brigadier General, for four years from February 14, 1917, was confirmed by the Senate on January 19. AVIATION AND AERONAUTICAL ENGINEERING extends its congratulations.

General Squier's accomplishments in the field of electricity, his experience in Europe and his marvelous accomplishments in the five short months during which he has been the Officer in Charge of the Aviation Section make him fitted for his new duties.

The possibility that the Aviation Section will soon be organized as a separate unit with a brigadier general of its own renders it likely that in the near future the aviation industry will be able to welcome General Squier back to a position where he will once more be devoting his entire time to the interests and development of aeronautics.

Volume II

With this number, AVIATION AND AERONAUTICAL ENGINEERING begins its second volume. The size of the issue is an evidence that the publication has won for itself a place in the industry. A semi-monthly technical journal, laying emphasis upon scientific accuracy and precision was needed. The support which the industry has given the periodical has been gratifying.

The object of this publication is to be of the greatest practical value in advancing the interests of the industry and assisting its development. Suggestions that will help to increase its usefulness will be deeply appreciated.

The Trend of Design in Foreign Aeronautic Engines

By Frank H. Trego

Owing to the confidential character of the information upon which the compilation of the accompanying charts is based, it is not advisable to give the names of the thirteen engines considered, but it may be stated that the revolving type has been eliminated and none but the fixed type are employed in compiling the various diagrams.

The same engines are used in all of the charts and they are numbered, so that any particular engine may be followed throughout, and its characteristics noted according to its horsepower, bore and number of cylinders, wherein, in each case is shown the efficiency for piston displacement, the gasoline consumption, the weight per horsepower, the stroke-bore ratio and the general efficiency.

After a careful study of the charts it appeared that a formula could be devised which would show the standing or efficiency of any engine from the user's standpoint, and of course that is the standpoint from which all engines should be judged. This formula is:

$$\frac{\text{H.P. per cubic inch of piston displacement}}{\text{Weight per H.P.}} = \text{Efficiency}$$

In horsepower per cubic inch of piston displacement, the greater the figure, the higher the efficiency of the engine for its volume. In weight per horsepower, the smaller the figure, the higher is the efficiency of the design.

Using these two characteristics in the formula we obtain a result which seems to indicate at a glance the desirability of the engine for the purposes of aviation; for, if the weight per horsepower is low, then the quotient will be high, and if the horsepower per piston displacement is small, then the quotient will be small, etc.

Example:	*A*	*B*
Engine weight complete, pounds	1,400	735
Horse-power	350	140
Weight per horse-power	4.25	5.25
Horse-power per cubic inch of piston displacement	.235	.154
Horse-power per cubic inch piston displacement / Weight per horse-power.	.055	.0325

The formula therefore tells the story, as Engine A shows a much higher result than Engine B for it shows higher horsepower per piston displacement, thus having a high efficiency for its cylinder size, and its weight per horsepower is low; showing that the design is a better one for aviation.

From my own experiments during the last year, I am now convinced that the possibilities within the next year will show an engine with characteristics as follows

Horse-power	500
Weight per horse-power, pounds	3
Horse-power per cubic inch piston displacement	.325
Efficiency	.108

It may be readily seen that this is a great improvement over any engine shown on the charts.

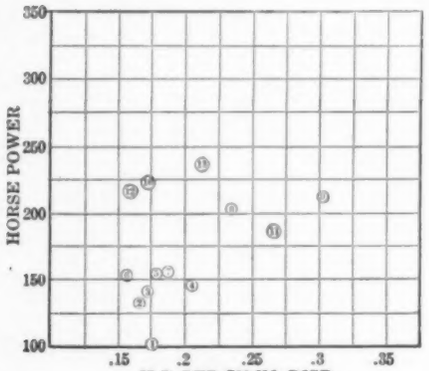
The designer's difficulties lie in several directions in the building of aeronautic engines. In the automobile engine, he is not confronted with the vital factor of weight, whereas this is one of the most important things to be considered in the airplane. The aeronautic engine must be so constructed that it will be capable of running constantly at full power and speed from the moment it leaves the factory for it cannot be gradually worked in by the user as in the automobile. Then again, the engine must have the maximum of reliability under these trying conditions, for a stop is serious and in the automobile it is not.

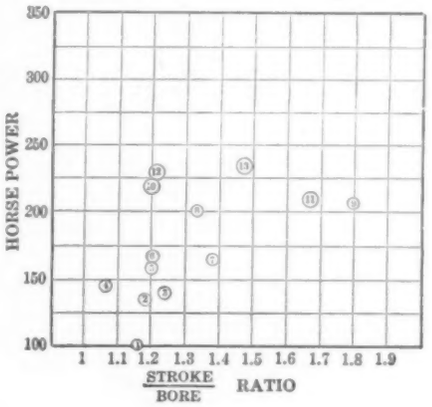
Owing to the high efficiency and duty required, the engine must be constructed of the very best materials, and the heat-treatment of the steels used becomes one of the most trying of the problems.

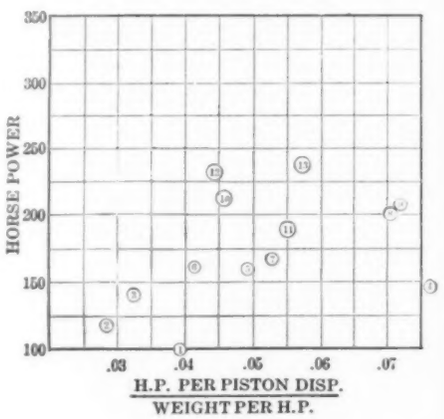
Lubrication is a vital issue for at the speed and power developed, an instant's lack of oil will destroy the engine. This item has been the fate of many a racing engine on the speedways and has been a problem ever since racing began.

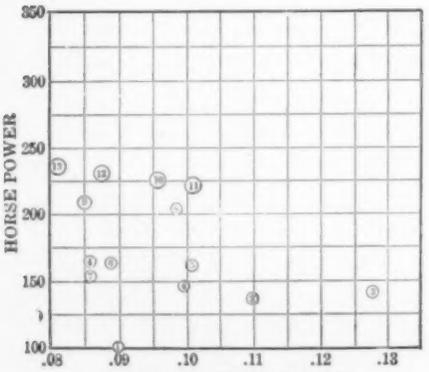
Tolerances for fits throughout the engine must be many times more exact than was ever thought necessary in the automobile engine, and in many cases as small an error in a fit as .0005-inch will mean the success or failure of the part.

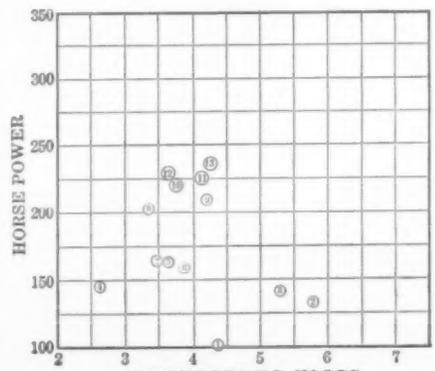
From the later reports from the war zone, it is clearly indicated that the tendency is towards higher and higher power in single units and thus the engineer is drawn into a new field of design with which he is totally unfamiliar and where past practice is of little avail. The design of a successful engine of 100 to 150 horsepower cannot be followed in proportion for the building of an engine of 300 to 400 horsepower, and

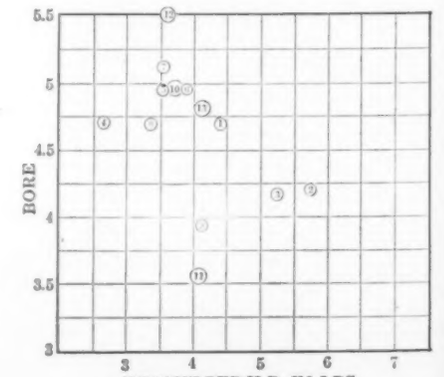












conditions in the larger engine develop which were not experienced at all in the smaller one.

I believe that the proper way to design a new engine is to build it as light as one dares and then correct those points which show weakness under the new conditions, for it is impossible to obtain light enough weight with safety if the engine is built heavy and then the weight trimmed here and there, for the engineer is then only guessing at which part he may cut down and the duration of the development will be much longer.

As will be seen by the charts, the results of the designers of different engines abroad are at such wide variance, that no settled style or type seems to have been reached. The twelve and eight cylinder engines are increasing and the Sunbeam latest type has eighteen cylinders, with an output of 330 horsepower and a bore of about 4¾ inches. Propeller speeds are rapidly decreasing. Six months ago a speed of 1,400 revolutions per minute was allowed the designer of the engine, but now the speeds for large propellers has dropped to 1,000 to 1,100 revolutions per minute so that the geared type of drive is becoming almost universal in order to get the benefit of higher speeds of the engine to obtain the necessary horsepower. The wrecking of the larger propellers at high speed has made such speed prohibitive.

The modern aeronautic engine must have electric or other starting or cranking apparatus, and electric generator for lights is now demanded. Requirements also call for an air pressure pump so that the gasoline may be used under pressure to the carburetor. The engine must be designed to use low grades of fuel, for as the number increases, the high grades of gasoline will become very scarce as with the automobile, and an engine which must have high test gasoline will be unserviceable in the very near future.

The data available at this time is naturally very vague and incomplete, and there is practically nothing in books on engine design which will lead the engineer straight in working out the ideal aeronautic engine. It is safe to say that no really satisfactory engine has as yet been built in the world when compared with the generally satisfactory performance of the automobile engine, and an immense amount of research work is yet to be done before such an engine will be offered to the aviator.

Naturally, the development work is a costly proposition, for the parts of the aeronautic engine are expensive as compared with the automobile engine, so that the successful engines will be brought out by those who have the necessary finances to endure this large expense. What we want now is data on the performance and characteristics of all the engines we can get, and from these figures, we will eventually develop the ideal.

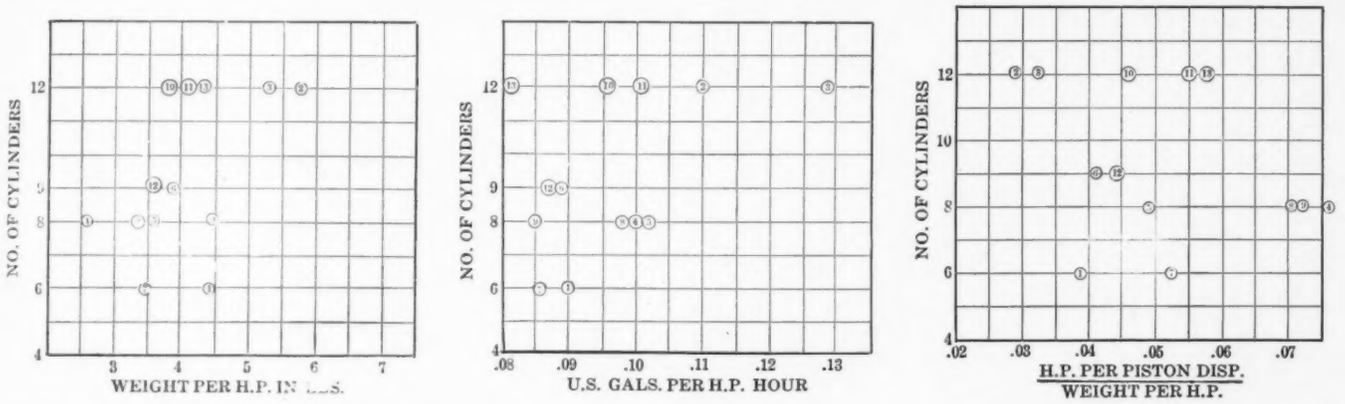
The tendency of the demands of the war zone is now positively towards single unit power plants. This has been brought about by the increasing power of the anti-aircraft guns, which are now able to reach successfully to altitudes of 16,000 feet. It is almost impossible, due to weight and mechanical difficulties, to armor the multiple power plants, whereas the single plant can be armored together with its gasoline tank, pipes, etc., and it is claimed the plane handles more easily with the weight concentrated in the center than with it spread out on the wings.

Multiple units have been largely necessary owing to the low power of available engines; but this difficulty is being overcome to some extent by a few successful engines of high horsepower, such as the latest type of Sunbeam showing 330 horsepower for steady running.

Of course, for other than military purposes, the single or multiple question is rather immaterial, but the military airplane will probably govern largely the design of all, as it will be developed into the most efficient type. Scouting machines must now attain a speed of 150 miles per hour, and in England, at least, practically no engines of under 200 horsepower are used for this purpose. The smaller engines are employed now solely for school purposes.

Aerial Navigation Over Water

In a paper presented to the Society of Automobile Engineers, Elmer A. Sperry called attention to the faults of the magnetic compass for aeronautical work, the most serious of these being its inaccuracy when the machine is banked, and its tendency to lag in action, due to the swirling of the liquid in the bowl. These disadvantages have led the Navy Department to call for a gyroscopic compass as standard equipment on Navy machines.



Even the best of compasses he pointed out cannot give the course unaided when flying in a side wind, as a lubber line set to coincide with the axis of the airplane does not then show the true direction of progress over the ground. Some form of drift indicator is then necessary, especially over the water, where there are no landmarks to guide the aviator.

The Sperry drift indicator, in its most modern and complete form, gives both the true direction of progress and the actual speed relative to the ground. It consists of a number of telescopic observing tubes disposed radially around a circle. This circle can be turned by a crank, and the speed of rotation is given by a revolution-meter. The speed is varied until any given point on the earth's surface, as seen through the tubes, appears to remain stationary during the time that it is under observation. It is then evident that the projection of the line of vision on the earth's surface must be traveling backward at the same speed that the airplane is traveling forward, and, knowing the altitude of the machine and the angular velocity of the vision tube, the absolute speed can be readily determined.

There is also an azimuth circle, so that the circle of vision tubes, each of which has a cross-hair on the object-glass, may be turned through any desired angle. The tubes are stationary and if one sights through one of them and turns the graduated circle until stationary objects in the field of view pass across the filed in lines parallel to the cross-hair, the reading of the graduated azimuth circle will give the angle between the axis of the airplane and its actual direction of travel. Since this measurement is much more important that that of absolute velocity, except for certain military purposes, the drift sets are now made for ordinary use without the rotating tube feature.

In flying over water, the wave-crests must be utilized as reference points for observation. Since these crests themselves are moving, a correction must be introduced for this fact, the correction being a function of the sine of the angle between the directions of motion of the waves and the airplane. The velocity of the wave-crests, which also enters into the correction, may be estimated from the distance between crests.

Progress of the Aviation Section

A semi-official account of the work being done by the Aviation Section, Signal Corps, U. S. A., indicates in a general way the great strides that have been made in American Military Aeronautics since the President signed, at the end of last August, the appropriation bill carrying $13,281,666 for military aeronautics. The seven air squadrons of the Regular Army will, it now seems certain, be fully organized and equipped before the end of the fiscal year, June 30, 1917. The difficulties of securing proper personnel and material render it doubtful whether the twelve reserve squadrons to correspond to the twelve militia divisions can be organized before June 30, but the Aviation Section hopes and expects to have six of these squadrons completed.

The two main problems which confronted the officers of the Aviation Section when they received authority to spend the $13,281,666 appropriation were the problems of getting satisfactory personnel and material. As a corollary of these problems, no less important but far more simple once they were solved, was the problem of organizing the personnel and material into tactical military units for service in time of war.

The officers recognized that the appropriation was passed with the idea that seven squadrons should be organized for the Regular Army and twelve squadrons for duty with the National Guard divisions, either squadrons composed of guardsmen or members of the Officers and Enlisted Reserve Corps.

REGULAR ARMY

The regular personnel together with a limited number of National Guardsmen not in federal service are being and will be trained at the San Diego school. The course of training at this school has been unusually carefully worked out and the details have received most minute attention. The staff of instructors and the equipment of machines and accessories at the school make it possible to handle satisfactorily 75 pupils at the same time. One of the great advantages of this school is that it insures uniformity in the method employed in the training of all regular army fliers.

The seven air squadrons of the Regular Army are either located or are being located at the following places:

First Squadron, Columbus, N. M.
Second Squadron, Manila, P. I.
Third, Fourth and Fifth Squadrons are being organized at San Antonio, Tex.
Sixth Squadron will be organized at Fort Kamehamcha, Hawaii.
Seventh Squadron will be organized on the Canal Zone.

Of these seven squadrons it will be noticed four are land squadrons and three seaplane squadrons. All four land squadrons are now in the southern department. This is not the permanent arrangement contemplated but is made necessary by the state of affairs on the southern boundary of the United States. All four of these squadrons will have reconnaissance machines for use in conjunction with the mobile army. As this equipment must always be up to date and ready for active service upon very short notice in any locality and under any circumstances, it is very hard to procure.

Airplanes are hard to get in sufficient quantities and with promptness. The experience of officers in the Aviation Section leads them to the belief that estimates have to be made and orders placed for airplanes about a year ahead to insure delivery of specialized military types.

A corps of inspectors has been organized consisting of an officer, a consulting engineer and forty-two inspectors. Besides the inspectors on duty in Washington at the War Department and in the Bureau of Standards at least one inspector is permanently stationed in each of twelve airplane and airplane engine factories which are engaged in turning out heavier than air equipment for the army.

Construction work has not been neglected by the army itself, a board consisting of an officer, an aeronautical engineer and three mechanical draftsmen have been engaged and are attempting to solve some of the problems met with in building airplanes and accessories, engines, motor trucks and motor cycles, cameras, electrical and other signalling equipment.

The lighter than air work of the army has been placed in an officer's charge and he has been ordered to assemble at Fort Omaha, Nebraska, sufficient material and a competent staff to undertake the instruction of fifty pupils.

RESERVE SQUADRONS

Up to the present time it has been found impossible to organize tactical units of military value for air service in the National Guard.

However, sufficient personnel is authorized for the Reserve corps to man the twelve squadrons which are expected to operate with the National Guard divisions.

Difficulties in securing satisfactory personnel and material without some development have caused delay in organizing these reserve squadrons in some parts of the country. But a concrete plan for immediate development has been proposed under which several reserve squadrons can be organized very speedily. The plan is to organize these reserve squadrons in two types, pursuit squadrons for fighting off hostile planes and water squadrons. A reserve squadron of each type is eventually contemplated for the vicinities of Chesapeake Bay, the Delaware River, New York, Boston, San Francisco and Puget Sound.

The first squadron to be definitely organized will be the First Reserve Squadron at Mineola, L. I., which will be a pursuit squadron, and the next will be the Second Reserve Squadron, a water squadron for operations in connection with Coast Artillery. It will be organized at Essington, Pa., near Philadelphia.

Proper sites for the remaining squadrons as well as for the two mentioned above and for other necessary stations will involve an investment of $4,000,000 in real estate and equipment.

The training of the personnel for the reserve squadrons is very difficult at present and many departures have to be made from the plan which is eventually expected to be adopted. Two civilian schools are now approved by the war department for training reserve personnel in primary flying. More schools will probably be approved as soon as their courses of instruction become more thorough, but until the civilian schools come up to requirements the Government schools are being used for giving primary training. Advanced training will aways be given at regular army training stations and at least one station capable of handling fifty advanced pupils will have to be instituted in each of the military departments of the United States.

In some departments, owing to climatic conditions two stations will have to be organized. For example, in the Central department a school is maintained near Chicago and one at Memphis, Tenn. High winds, snow and cold in the North make flying difficult in winter. The army, however, must be prepared to fight under adverse conditions such as those prevailing in northern climates in winter. Therefore, the more advanced pupils must receive instruction during the winter in the northern stations while the less advanced pupils are sent south.

SUMMARY OF PROGRESS AND PROSPECTS

Summarizing the report, it would appear that in four months wonderful progress has been made in laying the groundwork for a real American aeronautical arm. In comparison with the size of the total regular army the Aviation Section bids fair to hold a very commanding position by the end of the fiscal year. The Regular Army will, considering its size, be well equipped with planes. Any increase in the regular or reserve establishments must be accompanied by at least a proportional increase in the aeronautical arm. Many difficulties and obstacles are still to be overcome. The personnel is not volunteering as fast as was expected and the material situation demands increased coordination, cooperation and standardization. If orders for military airplanes must be placed a year before the machines are delivered there is every likelihood that the machines will be out of date before an army pilot ever takes them into the air.

It is always necessary to remember that before the appropriation of last August the encouragement given the industry by the Government was negligible. Now that encouragement has come, together with great strides toward standardization, there is every reason to believe that production will soon be greatly speeded up. And with better construction conditions, better machines, quicker deliveries and, perhaps, lower prices will come the popularization of aviation which sooner or later is bound to be achieved and which, when it is achieved will in itself help to solve the personnel problem for the army.

Course in Aerodynamics and Airplane Design*

By Alexander Klemin, A.C.G.I., B.Sc., S.M.

Instructor in Aeronautics, Massachusetts Institute of Technology, Member of the Aeronautical Society of Great Britain and Ireland

and

T. H. Huff, S.B.

Instructor in Aeronautics, Massachusetts Institute of Technology

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PART 1—SECTION 13

Resistance Computations—Preliminary Wing Selections

An Example of Estimate for Parasite Resistance for a British Machine

The B.E.2, mentioned in Section 12, will serve as an example of the estimate of the total parasite resistance of a machine. The estimate was arrived at by the Royal Aircraft Factory after the most careful tests, both at the N. P. L. laboratory and in full flight, and is given in Table 1.

TABLE 1.

B.E.2; Weight, 1650 Pounds; 372 Square Feet Biplane Surface, 70 Horsepower Engine.

Estimated parasite resistance at 60 miles per hour.

Part.	Whence obtained.	Value in pounds per square foot of projected area.	Resistance in pounds.	
Struts				
8, 6′0″ × 1¼″	N.P.L. Test		4.2	
4, 4′0″ × 1¼″	"		1.4	
6, 3′0″ × 1¼″	"		1.6	
				7.2
Wings				
2, 20′ cable	"		29.5	
70, 12 G.H.T. wire	"		5.6	
52 strainers	Estimated		3.0	
				38.1
Rudder and elevators			2.0	
Body with passenger and pilot	N.P.L. Test		40.0	
Axle			2.0	
Main skids and axle mounting			1.0	
Rear skid			.5	
Wheels	N.P.L. Test		3.5	
Wing, skids, wiring, plates, step, silencers, etc.	Estimated		10.0	
				59.0
Exposed to a slip stream of 25 feet per second, for an airplane speed of 60 miles per hour, i. e., 88 feet per second.				
Body			40.	
4, 4′0″ struts			1.4	
2/3 of 3′0″ struts			.8	
50′ cable			6.7	
30′ H.T wire			2.4	
Rudder and elevator			2.0	
Rear skid			.5	
Fittings			2.0	
			55.8	
In slip stream resistance increased to			91.5	
Increase				35.7
Total				140.0

One of the most interesting features of this resistance estimate is the allowance for slip stream. The parts of the airplane included in the slip stream are, of course, taken within the area swept out by the propeller. The speed of the machine is 60 miles per hour, i.e., 88 feet per second, and the slip stream is 25 feet per second, i.e., 28.4 per cent, increasing the resistance of the parts involved by some 65 per cent.

Examples of Parasite Resistance Distribution in School Machines

Table 2 furnishes useful estimates of parasite resistance distribution for a number of standard school machines. The slip stream velocity has been taken as 15 per cent of the airplane speed, giving an increase in resistance of 32 per cent for the parts exposed to it.

Discrepancies in these values arise from a number of causes. The Martin has interplane ailerons, and the other machines have wing flaps. The Curtiss has a water-cooled motor with radiator in front. The machine designed at M. I. T. has a radiator above the upper wing. The Curtiss has a two-wheeled landing gear, while the Martin has a third wheel in front.

TABLE 2.

Percentage of Parasite Resistance.

Machine.	Body radiator heads, cockpits, windshields, 15% allowance made for slip stream.	Tail, rudder, stabilizer braces, wiring, etc.	Landing gear complete.	Wing bracing, struts, wires and fittings.	Ailerons or wing flaps, pulleys, braces, etc.	Expression for parasite resistance P in lbs., V in m.p.h.	Parasite resistance at 60 m.p.h.
Curtis 90 h.p., two place, 1893 lbs. tractor	39.5%	10.5%	17.5%	28.5%	4.0%	$P = .035V^2$	126 lbs.
Martin, 1800 lbs., 70 h.p. Renault	30.0%	18.8%	14.2%	14.8%	22.8%	$P = .042V^2$	151 lbs.
90 h.p. biplane, 1850 lbs., tractor, designed at M.I.T.	37.0%	15.6%	19.8%	27.6%	3.5%	$P = .032V^2$	115 lbs.

Two tractor machines, carefully designed by students at the Massachusetts Institute of Technology, gave the following figures:

Type.	Weight in lbs.	Engine.	Parasite Resistance Coefficient, V in m.p.h.	Allowing 10% increase for slip stream.	Resistance at 60 m.p.h.
Tractor Biplane Reconnaissance.	2300	120 h.p.	$P = .040\ V^2$	$.044\ V^2$	158 lbs.
Tractor Biplane Reconnaissance.	2885	125 h.p.	$P = .0485\ V^2$	$.0530\ V^2$	191 lbs.

Parasite Resistance Coefficient for a Sturtevant Seaplane

For a Sturtevant seaplane, weighing 2650 pounds, with a 140 horsepower engine, and where parasite resistance, on account of the floats, is higher than for a land machine of the same weight, the structural resistance is estimated as being given by the formula $P = .0532V^2$, and 10 per cent increase on all the parasite resistance is allowed for, bringing up the value to $P = .0576V^2$, or 212 pounds approximately, at 60 miles per hour.

Allowance for Slip Stream

The question of slip stream velocity is one of great complexity, and, in the present state of knowledge, it does not seem advisable to enter into very complicated calculations when working out performance curves. The estimated figures given for the various American machines seem to be very well borne out by tests in the field. The British allowance for slip stream increase was 28.4 per cent, and the one given by American practice is 15 per cent. It would be safe to say that if for the parts of the machine, within the area swept out by the propeller, the speed is increased by some 20 per cent, and resistance of those parts increased by some 44 per cent, a sufficiently accurate estimate will be made.

The other method adopted of increasing the total structural resistance by some 10 per cent to allow for slip resistance, though not so rational, has the advantage of being simpler, and is still in accordance with tests in the field. For a monoplane, where the parts exposed to the slip stream bear a larger ratio to the rest of the machine, an increase of 15 per cent on the total structural resistance is probably advisable.

* This Course commenced in the August 1, 1916 issue of Aviation and Aeronautical Engineering will be completed in 24 issues.

Preliminary Estimates for Parasite Resistance

In making preliminary estimates for a machine, a really difficult point is the allowance to be made for parasite resistance. Some authorities allow for the parasite resistance by finding the resistance of the body and multiplying it by four for a biplane and by three for a monoplane. Such rules can only be roughly correct, and it is best to refer to data for standard machines and select parasite resistance coefficients of a machine of similar type and weight. The figures given in this section will be sufficiently accurate for a preliminary design.

Preliminary Selection of Wing Section and Area

A great many ingenious methods have been devised for the selection of correct wing sections and areas for the preliminary design of a machine whose engine-power and specification are given. Eiffel, among others, has developed a very complete system. It seems best, however, to employ the simplest and most straightforward trial and error methods, based on the following rules:

(1) From a consideration of standard practice, select the loading per horsepower and hence weight of the machine.
(2) From a consideration of standard practice, select the approximate loading per square foot.
(3) From some such considerations as those given in Section 4 (AVIATION AND AERONAUTICAL ENGINEERING, September 15, 1916) select two or three wings which are likely to give the qualities desired.
(4) Assume a parasite resistance coefficient which from a standard practice is likely to apply to a machine of the type and weight in question.
(5) Draw up a number of performance curves varying:
    (a) Wing sections
    (b) Area for each wing section
    (c) Assumed propeller efficiency curves.

Some data on standard practice will be given in the Second Part of the Course, and the above rules will be applied to the design of a standard machine.

Reference for Section 13

Barnwell's Aeroplane Design.
British Report, 1912-1913. No. 86.

NOTES ON AERONAUTICAL UNITS AND CONVERSION FACTORS

In the fundamental equation of the form $R = K A V^2$, $K = \frac{R}{AV^2}$ and the value of K will depend on the choice of units for R, A and V. The combinations which have been most used are the following:

R	A	V
pounds	square feet	feet per second
pounds	square feet	miles per hour
kilograms	square meters	meters per second (used by Eiffel)
kilograms	square meters	kilometers per second

It is only a quesiton of arithmetic to obtain the conversion factor from one set of units to another. Taking a concrete case to transform from kilograms, square meters, and meters per second units to pounds, square feet, and feet per second units, it should be remembered that:

1 kilogram = 2.204 pounds
1 meter = 3.281 feet
1 square meter = 10.76 square feet

To transform R from kilograms to pounds multiply K by 2.204.

To transform A from square meters to square feet divide K by 10.76^2.

To transform V from meters per second to feet per second divide K by 3.281^2. The conversion factor becomes therefore

$$\frac{2.204}{(10.76) \times (3.281)^2} = .01903$$

Another system possessing great advantages for some purposes which is employed by the British National Physical Laboratory, is known as the absolute system of units. In this system the formula is written $R = K\rho \frac{AV^2}{g}$ and $K = \frac{gR}{\rho A V^2}$, in which ρ = density of the air or other medium, and g = acceleration due to gravity.

If a consistent system of units is employed ρ will retain the same value in all systems, R being an experimental constant for any one set of conditions. This is fairly clear from the nature of the equation, since it represents a relationship between the resultant force, and all the other physical factors involved. A rigid demonstration by the theory of dimensions is available however.

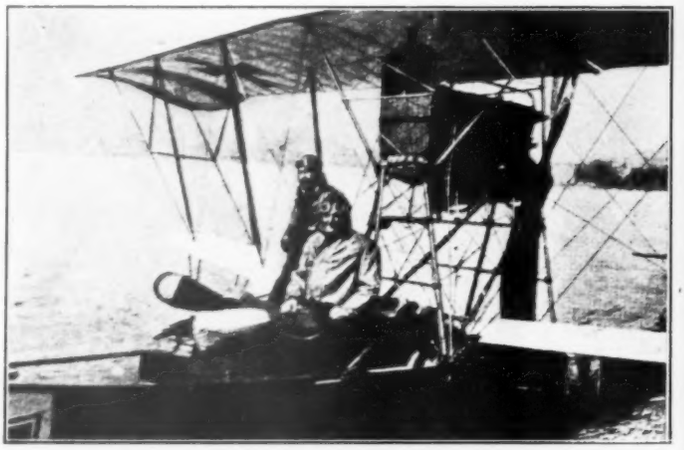
The following conversions are likely to be of use:

To CONVERT INTO POUNDS SQUARE FEET, FEET PER SECOND UNITS FROM
Pounds square feet, miles per hour units multiply constant by..... 0.46490
Kilograms square mile, meters per second units multiply constant by 0.01903
Kilograms square mile, kilometers per hour units multiply constant by 0.24660
Absolute units multiply constant by..... 0.00237

To CONVERT INTO POUNDS SQUARE FEET, MILES PER HOUR UNITS FROM
Pounds square feet, feet per second units multiply constant by..... 2.1510
Kilograms, square meters, meters per second units multiply constant by 0.4094
Kilograms, square meters, kilometers per hour units multiply constant by..... 0.5305
Absolute units multiply constant by..... 0.0051

Teutonic Seaplanes

In the long series of valuable articles on German and Austrian airplanes, motors and accessories, that M. Lagorgette has contributed to *L'Aerophile*, are some interesting comments on the seaplanes of the Central Powers. The Austrian pusher-type flying boat, illustrated herewith, has wings with a very decided sweep back, and a maximum span of 50 feet. The lower wing is considerably smaller than the upper, both in span and chord. The system of trussing and motor support is rather complex. There is a very considerable stagger. The boat is of the long-hulled type, and is extremely narrow. The motor is a 6-cylinder Mercedes, which was described in AVIATION AND AERONAUTICAL ENGINEERING, September 1, 1916, and a honeycomb radiator is used.



AUSTRIAN FLYING BOAT WITH MERCEDES ENGINE

The author also gives a brief description of a German tractor seaplane with two floats. This is very much like the old Albatros biplane shown in AVIATION AND AERONAUTICAL ENGINEERING, August 1, 1916, but is distinguished from other German machines of recent construction by the fact that the exhaust is discharged below the lower plane instead of above the upper.

Aeronautical Patents

Copies of these patents may be obtained for five cents each by addressing the "Commissioner of Patents, Washington, D. C."

ISSUED JANUARY 16, 1917.

1,212,954. Filed April 8, 1916. To Allen G. Holder, Jr., Lucedale, Miss. An airplane.

1,213,000. Filed January 21, 1916. To Lewis Philip Perew, North Tonawanda, N. Y. A hydroaeroplane.

ISSUED JANUARY 23, 1917.

1,213,453. Filed February 21, 1916. To Mark Lambert Bristol and Holden Chester Richardson, U. S. Navy. Float for Airplanes.

1,213,585. Filed May 12, 1916. To William H. Bush, Framingham, Mass. A flying machine.

1,213,332. Filed April 14, 1914. To Everard Richard Calthrop, London, Eng. A parachute.

1,213,377. Filed December 30, 1914. To James W. Ingleton, Astoria, Oregon. An airplane.

Aeronautical Manufacturers Association Formed

To secure closer co-operation between the Government, individual airplane manufacturers and the Aero Club of America, a meeting of Aeronautical manufacturers was called by Mr. Harry Bowers Mingle, President of the Standard Aero Corporation of New York, on January 24, 1917. At this meeting, held in the Woolworth Building, the following concerns were represented: Aeromarine Plane & Motor Company, by Inglis M. Uppercue; Wright-Martin Aircraft Corporation, by Edward M. Hagar; Standard Aero Corporation of New York, by Harry Bowers Mingle; John D. Cooper Aeroplane Company, by John D. Cooper; Samuel S. Pierce Aeroplane Company, by S. S. Breese, and Witteman-Lewis Company, by C. R. Witteman and S. C. Lewis.

The Thomas Aeroplane Company and the Sturtevant Aeroplane Company were represented by proxies.

At the meeting there were also Mr. L. D. Waldon and Mr. Howard E. Coffin, the latter the chairman of the Pan-American Aeronautical Exposition to be held in the Grand Central Palace, February 8-15. Mr. Coffin is also a member of the Advisory Commission of the Council of National Defense.

After an informal discussion, at which the purpose of the meeting was stated by Mr. Mingle and Mr. Coffin, it was unanimously:

Resolved, That a temporary organization of manufacturers be immediately formed, Mr. H. B. Mingle to be appointed as chairman and Mr. Inglis M. Uppercue as secretary.

Further resolved, That the chairman appoint a committee of five, of which he shall be a member, to act in show matters and to arrange for an early meeting of the Board of Governors of the Aero Club, relative to the handling of this and future shows, and to report later to a meeting to which all manufacturers of airplanes shall be invited on the matter of the formation of a permanent organization.

The Committee on Organization issued invitations to all of the manufacturers of airplanes for a meeting to be held Wednesday, January 31st, in order that a permanent organization of Aeronautical manufacturers be completed for the Pan-American Aeronautical Exposition.

Lieut.-Col. George O. Squier Promoted

The United States Senate has confirmed the appointment of Lieut.-Col. George O. Squier to the office of Chief Signal Officer, U. S. A., for four years, with the rank of Brigadier-General, to take effect February 14, 1917, on which day Brigadier-General Scriven, the present head of the Signal Corps, will retire from active service on account of age.

General Squier graduated from West Point in 1887 and entered the Army as a second lieutenant, being assigned to the 3d Field Artillery. He later transferred to the Signal Corps. While stationed at Fort Monroe, Virginia, he took a course in electrical engineering in Johns Hopkins University, in addition to performing his military duties.

He saw active service both during the Spanish war and throughout the entire Philippine rebellion of 1900-02. He has to his credit many telegraphic inventions which are recognized by scientists throughout the world as the products of an extraordinarily energetic and brilliant mind.

For four years he was the military attaché of the United States to Great Britain, and this tour of duty ended last May when he returned to the United States to undertake the duties of Officer in Charge of the Aviation Section.

General Squier was the first passenger ever carried in a heavier than air flying machine and he also made the specifications of the first machine ever purchased by the United States Government, or for that matter by any Government (the Wright machine).

More Than 300 Army Airplanes Under Order

On January 1, the United States Army had the following airplanes in service: Curtiss, 50; Martin, 15; Standard, 6, and Sturtevant, 2, making a total of 73 machines. The following airplanes were under order, according to Brigadier-General Scriven's testimony before the House Committee on Military Affairs: Wright-Martin, 8; Curtiss, 138; Burgess, 38; Burgess-Dunne, 1; Standard, 61; Sturtevant, 26; L. W. F., 2; Thomas, 2; Christofferson, 2; Aeromarine, 22; Heinrich, 2, making a total of 302 machines for which orders have been placed.

Purchases had been approved, but the orders had not been placed up to that time, for: Thomas one-place pursuit machines, 4; twin-engined seaplanes, 52; Curtiss airplanes, 3. This makes a grand total of 434 machines either in service, under order or the purchase of which has been approved. Also it is understood that since January 1st, the Army orders for two-place reconnaissance tractors made with the L. W. F. Engineering Company have been increased by more than a score.

Navy Orders Placed in 1916

The following contracts were placed during 1916 by the Navy Department:

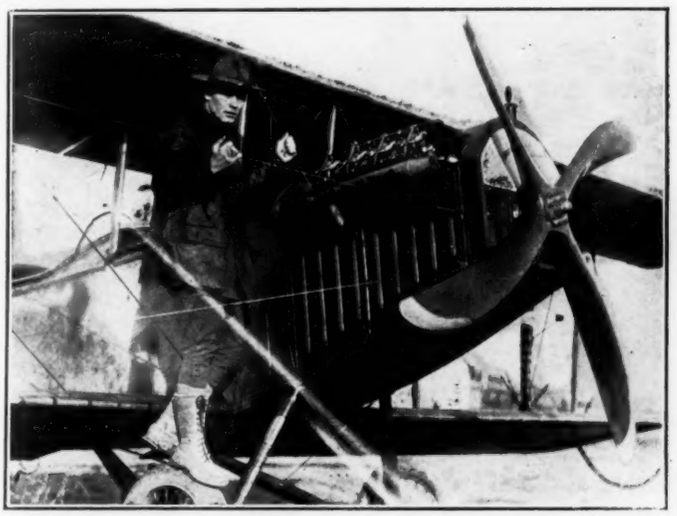
Names of Companies.	Number.	Type.
Aeromarine Plane and Motor Co.	3	100 h.p. Tractors.
The Burgess Co.	6	125 h.p. Tractors.
Curtiss Aeroplane Co.	9	100 h.p. Pushers.
	1	2-100 h.p. Twin Tractor.
	30	100 h.p. Tractors.
Goodyear Tire & Rubber Co.	3	Kite Balloons.
Standard Aero Corporation.	4	125 h.p. Tractors.
	1	2-135 h.p. Twin Tractor.
The Sturtevant Aeroplane Co.	6	140 h.p. Tractors.
	6	145 h.p. Tractors.
Thomas Bros. Aeroplane Co.	3	135 h.p. Tractors.
	2	2-135 h.p. Twin Tractors.

Total, 71 Seaplanes, 3 Kite Balloons.

Pensacola Notes

Interest at the aeronautic station at present centers in the arrival of 82-A, the big three-passenger airplane designed by Naval Constructor Holden C. Richardson, and built at the Washington Navy Yard. The weight of the machine is estimated at 6,000 pounds, and tests will be conducted as soon as the assembly work is complete.

Another notable recent arrival at the station is a two hundred horsepower Curtiss, considered the swiftest machine here. The machine is completely assembled and ready for trial flights, which will be conducted at once.



(C) International Film Service.

CAPTAIN JOSEPH E. CARBERRY, U. S. A.

Lieutenant P. N. L. Bellinger and Sergeant Crawford of the Marine Corps were slightly injured while testing a machine gun from an airplane, when the Burgess-Dunne in which they were conducting the tests fell from a height of fifty feet, landing in shallow water on the bay side of Santa Rosa Island. The machine was a total wreck, but the two occupants escaped with only minor injuries. Incidentally, this accident afforded the first opportunity for testing the new floating derrick, propelled under its own power. The test of the derrick was highly successful, though there was little of the airplane left to salvage.

The first formation flying to be conducted at the station was attempted on the arrival of Captain J. L. Jayne, who has been sent to the station as commandant, relieving Captain H. C. Mustin. Five machines were taken out, and all went well until a landing was made. Four of the machines splintered their propellers in landing, and the fifth one overturned on its nose, giving the pilot a ducking, but otherwise sustaining no injury.

While the choppiness of the water at the time of the flight is believed to have entered largely into the mishap to the propellers, the test also demonstrated the necessity of building the machines slightly higher from the water, allowing more clearance between the propellers and the water.

The Pan-American Aeronautical Exposition

The complete success of the Pan-American Aeronautical Exposition which is to be held in the Grand Central Palace, New York, February 8th to 15th, now seems assured. Public interest in the exposition has been aroused and the indications are that practically every firm of importance in the industry will be represented. Primarily, of course, the service of the exposition will be to make for a better realization on the part of the public of what aircraft are and of the high degree of development which they have attained, but the indirect service which the exposition will perform will be no less important.

Looking forward to the future of the aeronautical industry there is one problem which will probably be settled during the week of the show—that is, the problem of standardization. With probably $50,000,000 of aeronautical equipment to be contracted for in the United States this year, standardization is imperative. One of the largest factories in the country last year had to fill orders for no less than 2800 different sizes and specifications of bolts alone. With the co-operation of the S. A. E. these problems should be immediately solved.

The first meeting of the Society of Automotive Engineers, devoted exclusively to aeronautics, will be held in the afternoon and evening of February 9th, the second day of the exposition. The program in the afternoon will be devoted to aeronautical subjects with papers and discussions by engineers, and in the evening papers will be read by Elmer A. Sperry and Prof. F. W. Pawlowski. In connection with the exposition itself it is announced that Henry Souther, technical adviser of the Aviation Section of the Army, and others will discuss the standardization of army airplane parts.

The display of aircraft and accessories, which it seems likely will fill three floors of the exposition building, is the largest ever attempted in the United States. With such a display of air craft attracting the attention of the public and offering an opportunity to engineers for study and comparison, the success of the exposition is certain.

Canada May Rush Formation of Air Service

Persistent rumors are in circulation to the effect that the Dominion of Canada is about to undertake the training of a large number of aviators for the British Empire. The Aero Club of Canada, through its president, W. Hamilton Merritt, is said to have confirmed these reports.

The scheme of training a large number of Canadian aviators for European service was proposed many months ago by General Sir Sam Hughes. Recently General Hughes was relieved of his command and it is said that in England plans that he proposed are not looked upon with favor by the war office. However this may be, the rumors are that Canada is about to establish between ten and twenty schools of aviation, each school capable of undertaking the training of 100 student aviators. It is said that the Munitions Board in Great Britain will have directly under its charge the work of having constructed the 360 machines necessary to start the schooling.

It has recently been estimated that the British are using a total of 15,000 airplanes, 5,000 in training pilots and 10,000 in fighting work in France. Reliable diplomatic sources give the life of a machine at the front as three months, which would mean that if the British planes at the front number 10,000, the British factories are turning out over 3,300 planes a month. Under these circumstances it seems possible that the training machines used will be constructed in England and shipped over to this side of the Atlantic for use. However, there is no doubt that if large numbers of pilots are to be trained in Canada the British will attempt to build up and encourage a Canadian aeronautical industry.

Navy Takes Over Gallaudet Pusher

The seaplane constructed by the Gallaudet Company of Norwich, Conn., has been turned over to the United States Navy and shipped to Pensacola, Fla. Denison Gallaudet, secretary of the Gallaudet Company, with Ellsworth E. Williams, one of the company's mechanicians, recently left Norwich for Jacksonville, Fla., where Williams is to take a course of instruction in flying, upon the completion of which he will go to Pensacola and assist in setting up the Gallaudet machine there. The machine contains many novel features of design. It is a pusher seaplane in which two engines are geared to one four-bladed propeller, immediately in the rear of the pilot's seat.

Aero Club of Pennsylvania

At the annual meeting of the Aero Club of Pennsylvania officers were elected as follows: President, Joseph A. Steinmetz; first vice-president, William D. Harris; second vice-president, A. J. Drexel Biddle; secretary, George S. Gassner; treasurer. Laurence Maresch, and directors, Clarence P. Wynne, Rudolph Moscau, Louis S. Clarke, H. F. Bamberger, Harold Kneer and William H. Sheehan.

Robert E. Glendinning, a member of the club and well known as a prominent banker and aviator, has been offered a commission as major in the United States Reserve Corps.

Sergeant William Ocker, of the United States Army Aviation Corps, flew from Washington to Philadelphia in eighty-five minutes recently.

League Island as an Aviation Center

Efforts are being made to secure for Philadelphia the equipment required to make it the principal naval aviation station on the Atlantic coast, and the present Congress will be asked to appropriate $200,000 for this purpose. This movement has the backing of the Chamber of Commerce, the Board of Trade, the Manufacturers' Club, various trade organizations, the Alumni Association of the University of Pennsylvania, and practically every Philadelphia bank.

Geographically, the League Island Navy Yard divides the coast almost equally north and south. Before leaving Philadelphia after the return flight of the aviators, Charles Lyon, head of the technical department of the aviation station at Mineola, Long Island, said:

"Every effort will be made to have the League Island aviation field converted into the principal aviation station for the middle Atlantic coast. I have every confidence, from what I have learned, that the importance of the station is appreciated by the big interests of Philadelphia, and that the matter will be presented to Congress in proper form. Such a station must, of necessity, be located in the neighborhood of Philadelphia, and with the facilities already found at League Island, that is the logical place to establish it."

Tests on Hall-Scott A-5 Big Sixes

One of the sample test certificates which accompanies every lot of Hall-Scott engines is reprinted below. The Hall-Scott factory at West Berkeley, Cal., is now turning out 15 engines a week.

LOT CERTIFICATE NO. 6

20 Hall-Scott Type A-5 Aerial motors complete with tools and accessories, as per Exhibit "B."
20 Sets of spare parts for above motors, as per Exhibit "C."

Motor No.	Power Devel.	Average Speed.	Oil Consump. Gallons.	Gasoline Consump. Gallons.	Hours. Test.	Inspection.	Date of acceptance.
331	135	1283	.625	12.1	6	12 Oct.	14 Oct.
332	129	1280	.667	11.6	6	13 "	14 "
333	132.5	1272	.50	11.4	3	14 "	17 "
334	126	1262	.58	11.8	3	16 "	18 "
335	130	1260	.667	11.25	6	17 "	19 "
336	131	1282	.83	11.6	3	17 "	19 "
337	128	1285	.667	12.1	6	18 "	20 "
338	130	1292	.50	11.9	6 & 3	24 "	24 "
339	135	1280	.84	11.8	3	19 "	21 "
340	126	1262	.83	11.3	3	20 "	23 "
341	130	1285	.92	11.9	3	25 "	25 "
342	127.5	1273	.75	12	6	23 "	25 "
343	132	1270	.715	11.9	3	26 "	28 "
344	130	1282	.87	11.2	6	25 "	27 "
345	129	1295	.83	12.1	3	28 "	31 "
346	137	1282	.79	12	6	26 "	28 "
348	130	1285	.66	12	6	28 "	30 "
349	130	1285	.58	11.9	6	30 "	1 Nov.
350	138	1290	.625	12.1	6	30 "	1 "
351	131	1262	.58	11.7	3	1 Nov.	1 "

Date of shipment from factory, November 1, 1916.
Port of shipment, Vancouver, B. C.

Candidates for Chicago Army School Pass Examinations

Captain J. C. Morrow, commanding the United States Army aviation school at Chicago, has received word from Washington that ten applicants had successfully passed all examination for admission to the school. They are:

Joseph Van Walchshauser, Albert C. Adams, Austin E. Bibson, Charles W. Browne, George J. Kinberg, George W. Sawyer, Rudolph W. Schroeder, William A. Thompson, Michael L. Gerlowski and Victor J. Picard. All except Van Walchs-

AERONAUTICS FOR 1917

ANY forecast of the developments likely to take place in the aeronautical industry this year is extremely dangerous because the possibilities of the industry are unlimited. Primarily, however, the development for 1917 is likely to be of a military character. The United States Army, at the present time, has under order 302 planes from twelve different companies and the purchase of 59 more machines has been authorized, but as yet the orders have not been placed. Only 73 machines are now in service with the Army, and the resources of the constructors will be strained to make prompt deliveries of the machines that have been ordered.

The appropriation, which appears to be likely to pass, for the fiscal year of 1918 carries $15,600,000 for further development of the military air service. This great sum will undoubtedly be increased by purchases of military and training airplanes by foreign governments. The Army lighter-than-air section is also being developed at Fort Omaha, Neb., and at Pensacola, Fla., the Navy is preparing to carry on extensive experiments with lighter-than-air craft both of the dirigible and non-dirigible types. So far as types of airplanes for the Army are concerned we are likely to witness the development of fast pursuit machines capable of speeds up to probably 150 miles an hour with a fuel capacity which will permit five-hour flights.

It is also probable that larger machines capable of carrying tremendous loads and equipped with two or more engines delivering in excess of 1000 horse-power will be flown in this country either this year or next year. Especially for the Navy will these great weight-carrying machines prove valuable. The Navy problem of developing a machine capable of operating in conjunction with the main fleet is only to be solved by the development of airplanes of enormous carrying capacity and great radius of action.

It is more than possible that the development of lighter-than-air craft of the Zeppelin type may solve this problem. More than $5,000,000 will probably be spent in Naval Aeronautics in the fiscal year.

Preliminary steps are likely to be taken, too, by the Post Office Department. The transportation of mail by air route is an inevitable eventual development, and even military men expect that in a few years the Post Office Department will be a larger purchaser of machines than the Army and Navy combined. This development is certain to lead to the commercial use of airplanes. Transportation through the air has certain obvious advantages in that the expense is limited to the upkeep of the machines themselves. There are no rights of way to be purchased, no expensive roadbeds to be built, no tunnels to be dug, no bridges to be constructed. The difficulty that stands in the way is said to be lack of reliability. The flying record of the Army air service from January 1st to December 26th, 1916, throws an interesting light on this supposed difficulty. The total amount of time in the air was 3,356 hours and 56 minutes, during which time 7,087 flights were made and the distance traveled was 251,775 miles. The fatalities were none.

Perhaps before airplanes realize their commercial possibilities they will be used for pleasure purposes. Just as the coming of the pleasure automobile preceded the coming of the truck, so it is likely to be with planes. So, before another year passes, we can probably look with fair certainty to the development of a modification of the Army and Navy's training biplanes, which will be built for sportsmen. Such machines, having high factors of safety, comparative simplicity of construction, light weight, and good climbing qualities should, if the prices are within reason, go far towards popularizing the sport of aviation.

TABLE OF CHARACTERISTICS OF AMERICAN AIRPLANES

Maker's Name and Model	Span		Chord	Gap	Length Overall	Dihedral	Sweep Back	Stagger	Total Wing Surface	Ailerons on	Tractor or Pusher	Landing Gear	Engine Make and H.P.	Weight with Engine and 1 Hrs. Fuel	Useful Load	No. of Passengers
	Top	Bottom														
Amer. Aircraft Co. of Ind.	48′7½″	35′0″	5′6″	6′0″	25′0″	..	..	..	..	..	T.	..	..	1600	930	..
Atl. Aircraft Co. Twin....	48′0″	48′	6′	7′	28′6″	0°	0°	0°	550 sq. ft.	Both	T.	4 wheel	2 Aeromarine 85 H.P.	..	..	2
Aeromarine M-1.....	37′0″	33′0″	..	..	..	..	..	..	420 sq. ft.	..	T.	2 wheel	100 H.P.	..	..	2
Benoist H-17.....	45′0″	45′0″	5′3″	5′0″	24′0″	0°	0°	0°	455 sq. ft.	Upper wings	T.	2 or 3 wheel	Roberts 100 H.P.	1700	600	..
Benoist K-17.....	75′0″	65′0″	5′3″	5′0″	..	0°	0°	0°	705 sq. ft.	Upper wings	P.	3 wheel	2 Roberts 100 H.P.	2700	1300	..
Benoist E-17.....	45′0″	45′0″	5′3″	5′0″	..	0°	0°	0°	455 sq. ft.	Upper wings	T.	Boat	Roberts 100 H.P.	1700	600	..
Benoist C-17.....	75′0″	65′0″	5′3″	5′0″	..	0°	0°	0°	705 sq. ft.	Upper wings	P.	Boat	2 Roberts 100 H.P.	2800	1200	..
Burgess Dunne (New)..	46′6″	46′6″	6′9″	6′6″	31′	0°	30°	2′8″	650 sq. ft.	Upper & lower	P.	1 Pontoon	140 H.P.	..	..	2
Burgess Dunne Seaplane	46′0″	..	..	..	23′0″	0°	..	..	..	..	P.	..	100 H.P.	..	650	2
Burgess Dunne Navy Seaplane.....	45′2″	..	..	..	21′10″	0°	..	..	..	..	P.	..	140 H.P.	..	750	2
Burgess Hydroaeroplane.	46′9″	..	..	..	30′6″	0°	..	..	..	..	T.	..	100 H.P.	..	640	2
Burgess Land Machine..	46′9″	..	..	..	30′6″	0°	..	..	..	..	T.	..	100 H.P.	..	860	2
Burgess Land Machine..	49′0″	..	..	..	27′6″	0°	..	..	..	..	T.	..	100 H.P.	..	1000	2
Curtiss JN 4-B.....	43′7⅜″	33′11¼″	4′11½″	5′2″	27′3″	1°	0°	1′⅛″	359.69 sq. ft.	Upper wings	T.	2 wheel	Curtiss OX 90 H.P.	1400	585	2
Curtiss Twin JN.....	52′9⅜″	43′1¾″	4′11½″	5′2½″	29′	4½°	0°	9½°	450.28 sq. ft.	Upper wings	Twin T.	2 wheel	2 Curtiss OXX 200 H.P.	2225	1040	2
Curtiss R4.....	48′4⅛″	38′5⅛″	6′3 1/16″	6′2¼″	28′11¾″	3°	0°	10¾″	450.52 sq. ft.	Upper & lower	T.	2 wheel	Curtiss V2 200 H.P.	2300	1020	2
Curtiss N-9.....	53′3⅞″	43′0⅜″	5′0″	5′0″	29′10″	0°	0°	9′1⅛″	496.13 sq. ft.	Upper wings	T.	1 Pontoon	CurtissOXX 100 H.P.	2000	510	2
Curtiss F.....	45′2″	35′0″	5′2″	5′11″	28′0″	0°	0°	0°	420 sq. ft.	Upper wings	P.	Boat	Curtiss OX 90 H.P.	1500	600	2
Kyle Smith P.I.....	32′0″	22′0″	4′6″	4′6″	23′9″	1.5°	0°	20%	245 sq. ft.	Upper wings	T.	2 wheels	6 cylinder Radial	625	600	1
Lanzius L-1.....	38′0″	38′0″	5′6″	5′3″	25′0″	..	..	..	400 sq. ft.	Lanzius Patent	T.	2 wheels or 2 floats	Duesenberg 140 H.P.	1400	800	..
Lanzius L-2.....	28′0″	28′0″	4′0″	4′7″	24′0″	..	..	..	220 sq. ft.	Lanzius Patent	T.	2 wheels or 2 floats	Duesenberg 140 H.P.	1200	800	..
L. W. F.....	..	..	..	6′6″	..	1°	10°	10°	490 sq. ft.	Upper wings	T.	2 wheels	Thomas 135 H.P.	..	..	2
Lawrence-Lewis A-1....	30′0″	..	6′0″	4′8″	25′0″	..	..	6°	..	None	T.	Combined land and water	140 H.P. Hall-Scott A 5-a	1750	800	..
Lawrence-Lewis B-1....	42′0″	..	7′6″	5′8″	29′0″	..	..	6°	..	None	T.	Combined land and water	140 H.P. Hall-Scott A 5-a	2200	1500	..
M. F. P.....	45′0″	38′3″	5′3″	5′6″	27′0″	0°	0°	0°	..	Top Plane	T.	2 wheels	125 H.P. Hall-Scott	..	..	2
N.Y.Aero Constr.Co.A-1.	73′0″	44′0″	Top7′6″ Bot 6′6″	6′9″	37′0″	0°	0°	8′	820 sq. ft.	Upper wings	T.	2 floats	2 Hall-Scott 100 H.P. A 7-a	2822	1700	..
N.Y.Aero Constr.Co.A-2.	73′0″	44′0″	Top7′6″ Bot 6′6″	6′9″	34′0″	0°	0°	8′0″	820 sq. ft.	Upper wings	T.	4 wheels	2 Hall-Scott 100 H.P. A 7-a	2472	2050	..
Pacific Aero Products...	52′0″	43′6″	5′9″	6′6″	27′5′	2½°	0°	0°	480 sq. ft.	Upper wings	T.	2 floats	Hall-Scott 125 H.P.	2750	700	2
S. S. Pierce Co.....	26′0″	20′0″	4′0″	5′6″	20′0″	0°	0°	1′	184 sq. ft.	Upper wings	T.	2 wheels	S. S. Pierce B-35-40H.P.	660	..	1
Standard H-3.....	40′1″	40′1″	6′6″	6′6″	27′0″	3°	10°	1′3″	491 sq. ft.	Both	T.	2 wheels	Hall-Scott 140 H.P. A 5-a	2700	800	2
Standard J.....	44′0″	32′0″	6′0″	5′11″	26′7″	3°	5°	10°	433 sq. ft.	Upper wings	T.	3 wheel type	Hall-Scott 90 H.P.A-7	1750	500	2
Standard D Twin.....	62′4″	49′	7′0″	7′0″	33′6″	3°	0°	0°	760 sq. ft.	Upper wings	T.	2 floats	2 Hall-Scott A-5a 140 H.P. each	3300	1350	..
Standard Speed Scout..	26′6″	26′6″	5′0″	5′6″	22′7¾″	3°	10°	15°	225 sq. ft.	Both	T.	2 wheels	Hall-Scott 125 H.P. A-9	1192	425	..
Sturtevant S-4.....	49′6″	49′6″	7′0″	6′9″	28′0″	..	..	..	620 sq. ft.	Both	T.	2 wheels or 2 floats	Sturtevant 5-A 140H.P.	2025	525	2
Thomas R. D.-5.....	52′9″	34′	5′6″	5′3″	29′9″	4°	0°	0°	465 sq. ft.	Upper wings	T.	2 wheels	Thomas Model 8 135 H.P.	2500	1100	2
United Eastern Aeroplane Corp. H-M....	39′0″	30′0″	5′6″	6′0″	25′6″	1°	8°	9″	350 sq. ft.	Upper	T.	2 wheels	Curtiss OXX-2 100 H.P.	1200	800	..

TABLE OF CHARACTERISTICS OF AMERICAN AIRPLANES.—Continued

Maker's Name and Model	Span		Chord	Gap	Length Overall	Dihedral	Sweep Back	Stagger	Total Wing Surface	Ailerons on	Tractor or Pusher	Landing Gear	Engine Make and H.P.	Weight with Engine and 1 Hrs. Fuel	Useful Load	No. of Passengers
	Top	Bottom														
United Eastern Aeroplane Corp. A-M.....	42′0″	37′0″	6′0″	6′0″	29′6″	1°	None	9″	436 sq. ft.	Upper wings	T.	Single Float	Curtiss OXX-2 100 H.P.	1430	500	..
United Easrern Aeroplane Corp A-N.....	45′0″	45′0″	6′0″	6′0″	28′3″	1°	None	9″	482 sq. ft.	Both planes	T.	2 wheels	Hall-Scott 125 H.P. A-5	1550	900	..
Verville Gama S.....	40′0″	34′0″	5′0″	5′0″	25′10″	5°	0°	8″	350 sq. ft.	Upper wings	P.	2 floats	Curtiss OXX-2 100 H.P.	1500	450	2
Verville Beta.....	43′0″	37′0″	5′0″	6′0″	28′7″	Upper 0° Lower 5°	0°	9″	400 sq. ft.	Top plane	P.	Boat	100 H.P.	1640	350	2
Verville Gama L.....	40′0″	34′0″	5′0″	5′0″	25′0″	5°	0°	8″	350 sq. ft.	Top plane	P.	2 wheels	100 H.P.	1360	600	2
Witteman TT.....	42′0″	34′0″	5′6″	5′6″	27′2″	1½°	)°	0°	391 sq. ft.	..	T.	2 wheels	Hall-Scott A-7, 90H.P.	1460	550	..
Wright-Martin R.....	50′8″	36′10″	5′6″	6′0″	26′8″	1°	0°	1′7″	458 sq. ft.	Upper wings	T.	2 wheels	Hall-Scott A-5, 125 H.P.	2005	880	2
Wright-Martin V.....	39′8.5″	39′8.5″	5′9.5″	5′7″	27′2″	1°15′	0°	1′0″	430 sq. ft.	Both planes	T.	2 wheels	Simplex Model A Hispano-Suiza 150 H.P.	1725	805	..

TABLE OF CHARACTERISTICS OF AMERICAN AIRPLANE ENGINES

Maker's Name and Model	Number of Cylinders	Bore (Inches)	Stroke (Inches)	Piston Displacement (Cubic Inches)	H.P.	R.P.M.	Weight of Engine with Carburetor and Ignition	Gas Consumption
Aeromarine.....	6	4½	5⅛	449	85	1400	440	....
Aeromarine D-12.....	12	4⅛	5⅛	....	....	....	750	....
Brookmalti X.....	6	3½	4	....	24	....	....	....
Curtiss OX.....	8	4	5	502.6	90	1400	375	....
Curtiss OXX-2.....	8	4¼	5	567.5	100	1400	423	....
Curtiss V-2.....	8	5	7	1100	200	1400	690	....
Duesenberg A-4.....	4	4¾	7	496	140	2100	455	....
Duesenberg V-12.....	12	4¾	7	1488	250	1800	923	....
General Ordnance Type L.M.....	8	4¾	6½	920	200	....	876¼	....
General Vehicle Gnome Mono....	9	4.33	5.9	848	100	1200	272	12 gals. per hour at rated H.P.
Gyro K.....	7	4½	6	....	90	1250	215	8 gals. per hour at rated H.P.
Gyro L.....	9	4½	6	859	100	1200	285	10 gals. per hour at rated H.P.
Hall-Scott A-7.....	4	5	7	550	90–100	1400	410	....
Hall-Scott A-5.....	6	5	7	825	125	1300	592	....
Hispano Suiza.....	8	4⅜	5	672	154	1500	455	....
Knox Motors Co.....	12	4¾	7	1555	300	1800	1425	31.5 gals. per hr.
Maximotor A-6.....	6	4½	5	477	85	1600	340	....
Maximotor B-6.....	6	5	6	706.8	115	1600	385	....
Maximotor A-8.....	8	4½	5	636	115	1600	420	....
Orlo B-4.....	4	4½	5	....	50	1300	220 (bare)	....
Orlo B-6.....	6	4½	5	....	75	1300	270 (bare)	....
Orlo B-8.....	8	4½	6	753.3	105	1300	480 (bare)	....
Packard 12.....	12	4	6	903	225	2100	800	....
Rausenberger C-12.....	12	4⅛	6	930	100	1400	700	....
Sturtevant 5.....	8	4	5½	552.9	140	2000	580	....
Sturtevant 5-A.....	8	4	5½	....	140	2000	514	13.75 gals. per hr.
Thomas 8.....	8	4	5½	552.9	135	2000	630 with self-starter	59 lbs. per B.H.P. hr.
Thomas 88.....	8	4⅛	5½	552.9	150	2100	525 lbs. with self-starter	59 lbs. per B.H.P. hr.
Wisconsin.....	6	5	6½	765.7	140	1380	637	....
Wisconsin.....	12	5	6½	15.32	250	1200	....	....

Airplanes for 1917

The extent of the American airplane industry is shown by the fact that twenty-two active companies building machines in the United States to-day have given information about their products for the Exposition Number of AVIATION AND AERONAUTICAL ENGINEERING.

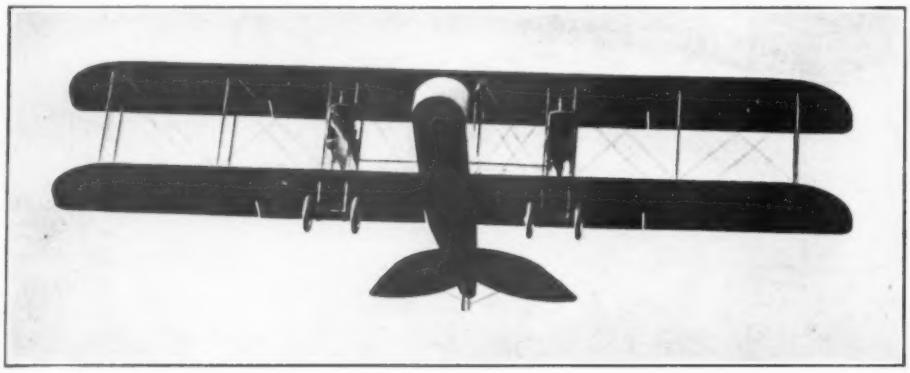
Two-place reconaissance tractor biplanes predominate in the types of planes announced for 1917, practically all of the companies being engaged in building machines of this type or of its smaller prototype, the two-place training tractor.

Two companies specialize in building sporting type airplanes. This aspect of the industry is certain to develop in the near future, as aviation is popularized.

The progress of the industry in the past year has not been marked by many radical developments, but by applications of the principles of engineering. The manufacturers realize that the building of an airplane is just as much an engineering problem as the building of a cantilever bridge. A few machines of very radical design appear, however, and if they live up to the hopes that their constructors have for them, the progress of the industry will be even more rapid than would have seemed possible, only as short a time as one year ago.

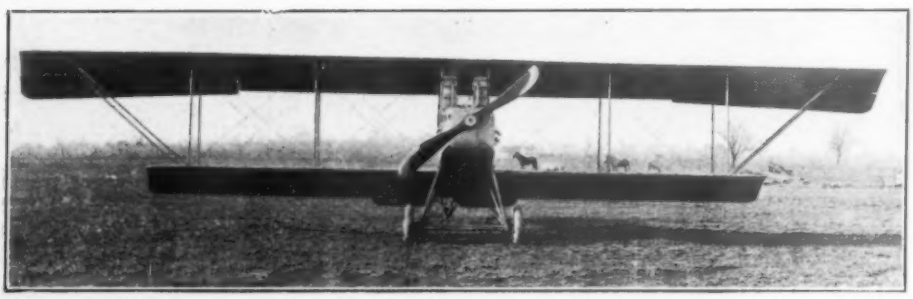
The Aeromarine Plane and Motor Company

The Aeromarine Plane & Motor Company announces a two-passenger training tractor biplane designed by Charles Willard. Liberal consideration has been made for the rough usage to which the bodies of school machines are subjected, and a high factor of safety has been employed in all wires, turnbuckles, fittings and woodwork. A special chassis allowing easy repairs and special shock absorbers have been designed for the machine. The R.A.F.6 wing curve is used and the leading edge of the wing is covered with thin wood to maintain a correct front curvature. Wings are covered with the best raw Irish linen and from three to five coats of lacquer are applied to protect the linen from the weather. Fuel tanks with four hours' capacity are included in the equipment. The stabilizer is of the double cambered non-lifting type.



(C) Underwood & Underwood

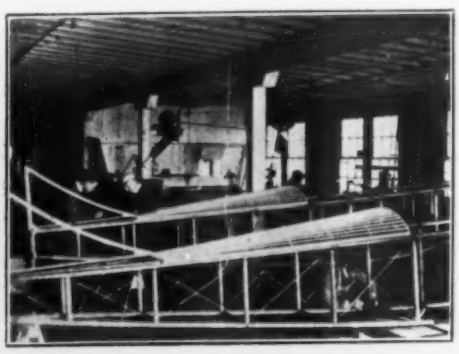
THE ATLANTIC AIRCRAFT COMPANY TWIN BATTLEPLANE



THE AMERICAN AIRCRAFT COMPANY OF INDIANA TRACTOR

American Aircraft Company of Indiana

The American Aircraft Company of Indiana, at Anderson, Indiana, manufactures a military tractor biplane, Model D, which is equipped with a 135-horsepower Sturtevant engine. In a recent trial flight the machine traveled from Anderson to Indianapolis, a distance of 40 miles, in 21 minutes, a speed of 118 miles per hour. The manufacturers claim a climb of 8,000 feet in 10 minutes. This company was incorporated January 13, 1916, by B. J. Foster, R. B. Allison, George Feeney, John Keefe and H. E. Cantwell. George E. Feeney is president of the company.



SHOPS OF THE BATES AEROPLANE COMPANY

* * *

Atlantic Aircraft Company

A twin-engined airplane using two six-cylinder vertical Aeromarine engines was designed, built, and flown last summer by Albert S. Heinrich for the Atlantic Aircraft Company. The machine, which showed excellent climbing and gliding properties, was tested at the Mineola field. The Atlantic Aircraft Company has recently dissolved.

* * *

Bates Aeroplane Company

A new model military tractor biplane is being developed by the Bates Aeroplane Company, 104 West Oak Street, Chicago, Ill. This company is also building two more new models of aeronautical engines. It has just perfected a new propeller section and special machinery is being installed to turn out these propellers at a very low price.

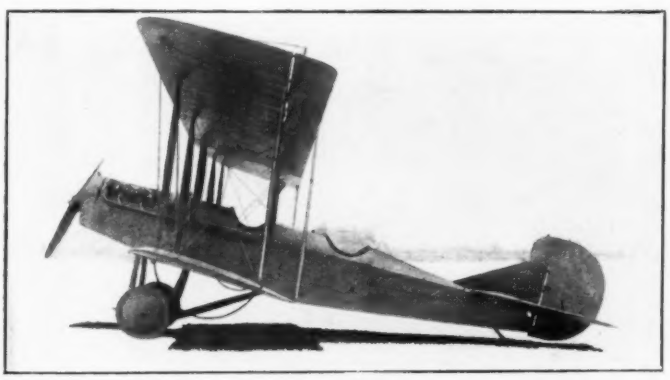
Benoist Aeroplane Company

Four models of airplanes are manufactured by the Benoist Aeroplane Company, 327 South LaSalle Street, Chicago, Ill., two land machines and two flying boats. The new model is the Type H-17 cross-country plane, and is a development of the different models from the designs that Tom W. Benoist has manufactured during the past four years. The chassis is of a three-wheel type, to lessen the danger of nosing over in a bad landing. A noticeable feature is the entire absence of cloth, wood or wire in the complete body of the plane, the whole being constructed of sheet steel. The engine is a 100-horsepower 6-cylinder Roberts, turning an 8 feet 6 inches diameter by 5 feet 6 inches pitch Paragon propeller at 1300 revolutions per minute. According to the manufacturers, 40 to 60 miles per hour was obtained with pilot, passenger and 100 pounds of extras and 4 hours' fuel. Other models are similar to those of previous years.

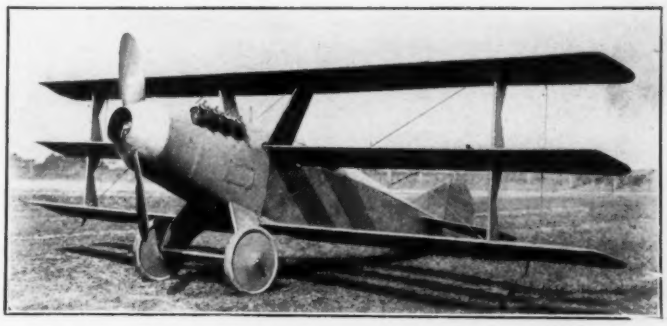
THE BENOIST TWIN-ENGINED BOAT

(C) Underwood & Underwood
THE CURTISS N-9 SEAPLANE

THE CURTISS JN-4



THE CURTISS R-4 MILITARY TRACTOR



THE CURTISS TRIPLANE

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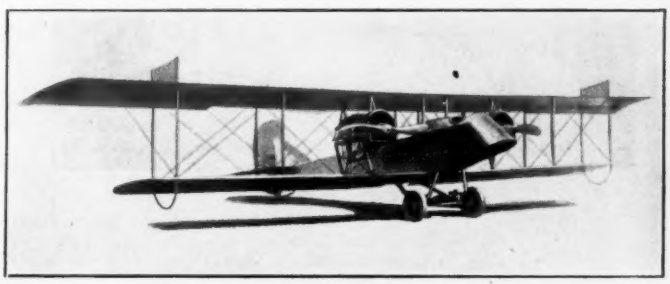
THE CURTISS FLYING YACHT



THE CURTISS JN TWIN BATTLEPLANE

The Burgess Company

A new Model Dunne reconnoissance airplane has just been completed and will be exhibited at the Pan-American Aeronautic Exposition by the Burgess Company of Marblehead, Mass. It is a development of former Dunne type airplanes and embodies the features of automatic stability which have made the Dunne type planes so popular with sportsmen in the past. The engine is of 140 horsepower. This machine is manufactured under the Dunne patents, and cannot stall, sideslip or nose dive. It will absolutely balance itself in flight, and with engine shut off will assume a perfect gliding angle.

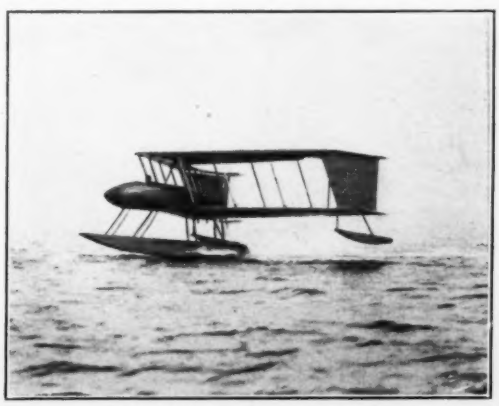
* * *

Curtiss Aeroplane and Motor Corporation

Five types of standard airplanes are announced for 1917, besides numerous special models which are being manufactured by the Curtiss Corporation at its factories in Buffalo and Hammondsport, N. Y. The popular JN-4B training machine is continued practically unaltered. The machine has a span on the top plane of 43 feet 7⅜ inches, with a chord of 5 feet and uses the Eiffel No. 36 wing curve. The loading is 5.3 pounds per square foot of supporting surface and 21.16 pounds per brake horsepower. Performance claimed is 75 miles an hour high speed and 43 miles per hour low speed, and a climbing speed of 3,000 feet in 10 minutes. The fuel consumption is 9 gallons per hour and the oil consumption is .03 pound per hour. The propeller is eight feet four inches in diameter and has a 5-foot pitch.

THE MODEL JN TWIN

The Model JN-4 twin is similar to the type of machine in which Victor Carlstrom made the flight from Newport News to New York, and from New York to Washington in 1916, and which, equipped with float landing gear, he used in winning the Curtiss marine flying trophy for 1916. The wing curve is the Eiffel No. 36; the loading is 7 pounds per square foot of supporting surface and 13.75 pounds per brake horsepower. The performance claimed is a high speed of 85 miles an hour and 48 miles an hour low speed, and a climbing speed of 4,000 feet in 10 minutes. The fuel consumption is 20 gallons an hour and the oil consumption is .06 pound per hour. The two OXX engines turn two seven-feet three-inch propellers of 6 feet 2 inch pitch.



THE NEW BURGESS-DUNNE

R-4 MILITARY TRACTOR

When the Mexican difficulty occurred last spring it found the United States Army practically lacking in proper aeronautical equipment for carrying on military reconnoissance, and an emergency appropriation of $500,000 was passed by Congress, with which the Aviation Section of the Signal Corps went to work to build up an air squadron for General Pershing. He was supplied with 12 Model R-4 Curtiss military trac-

tors of 160 horsepower each, and these machines proved so satisfactory that during the month of July they established a record of over 350 hours in the air and were so invaluable to General Pershing that he, a former cavalry officer, has recently been quoted as saying that in reconnoissance work "one airplane is worth a squadron of cavalry."

THE GENERAL AEROPLANE CO.'S VERVILLE PUSHER

The R-4 machine uses an R.A.F.6-wing curve and has a loading of 6.42 pounds per square foot of supporting surface and 16.21 pounds per brake horsepower. The performances claimed for this machine are 90 miles per hour high speed, 48 miles per hour low speed and a climb of 4,000 feet in 10 minutes. The engine, owing to recent improvements, is now rated at 200 horsepower instead of 160, as formerly. The fuel consumption is 20 gallons per hour and the oil consumption is .038 pounds per horsepower.

MODEL N-9

The United States Navy recently ordered 30 Model N-9 seaplanes for training purposes. This machine is equipped with float landing gear, dimensions of floats being length 15 feet 10 inches, width 4 feet ½ inch, depth 2 feet; main float is supplied with step. The wing curve is R.A.F.6 and the loading is 4.86 pounds per square foot of supporting surface

THE KYLE-SMITH SPORTSMAN'S BIPLANE

and 25.40 pounds per brake horsepower. The performances claimed are 70 miles per hour high speed and 45 miles per hour low speed, and a climbing speed of 2,000 feet in 10 mintues. The propeller is 8 feet in diameter and 4 feet 7 inches in pitch.

MODEL F BOAT

The familiar Curtiss Model Flying boat is continued in 1917 practically without change.

New models are being developed by the Curtiss Corporation constantly. The latest ones include a triplane speed scout of 29 feet spread and a 2-foot chord, which has made a speed of 119 miles an hour and a climb of 10,000 feet in 10 minutes. A larger triplane is also being tested at Newport News, Va. Large flying yachts to carry a useful load of over 10 tons have been designed and are in the experimental stage at the Curtiss factory. Some startling announcements are to be expected in relation to numerous different types of airplanes being developed by this company in 1917.

SCHOOLS

The Curtiss Corporation maintains flying schools at Buffalo, Hammondsport, Newport News and Miami, Fla. The schools at Newport News, Va., and Miami, Fla., have received the stamp of approval of the Aviation Section of the Signal Corps U. S. A., for the primary training of candidates for the Officers' Reserve Corps.

* * *

De Luxe Aeros, Incorporated

Experiment work in the development of flying boats is progressing under the direction of Harry Witts, president of the De Luxe Aeros, Incorporated, Bay Shore, L. I. The machines are to be staggered biplanes using an Eiffel wing curve. The hulls will have double concave bottoms forward of the step. An effort is being made to have these craft attractive for pleasure and sporting purposes. Deperdussin control will be used.

* * *

Kyle Smith Aircraft Company

A two-passenger tractor biplane for sporting and training purposes is manufactured by the Kyle Smith Aircraft Company of Wheeling, W. Va. The engine used is a 6-cylinder Radial, and the weight of the machine empty is only 600 pounds. The machine is built to carry two passengers and useful load of 600 pounds. It should appeal to sportsmen and do much to encourage aviation as a sport.

* * *

Lawrence-Lewis Aeroplane Company

Two models of a flying boat showing great originality in design are being manufactured by the Lawrence-Lewis Aeroplane Company, Peoples Gas Building, Chicago, Ill. Until these machines have been completed and demonstrated before the United States Government officials the manufacturers are not anxious to give out any details concerning their construction. The machines use no ailerons, and are without lateral control, depending entirely upon aerodynamic qualities for maintaining lateral balance. In both models, the one of 30 feet span and the other of 40 feet span, the manufacturers state that they intend to use a Hall-Scott Type A-5a, 140-horsepower 6-cylinder vertical engine.

* * *

General Aeroplane Company

The General Aeroplane Company of Detroit announces three types of airplanes of Verville design for 1917, a boat, seaplane and a land machine, all three models using eight cylinder V-type 100-horsepower engines. Besides building planes the General Aeroplane Company also conducts a school in connection with its factory in Detroit.

* * *

Lanzius Aircraft Company

A changeable angle of incidence machine, in which the wing incidence can be varied from 0 degree to 15 degrees, is being manufactured by the Lanzius Aircraft Company, of 149 Broadway, New York, in two models, one of 38 feet span and the other of 28 feet span. The ailerons on these machines are also built under the Lanzius patent, and in many other details this machine has originality of construction. The machines can be fitted with either wheels or float landing

THE LAWRENCE-LEWIS FLYING BOAT

gears for land or water use. It is the intention of the manufacturer to use 140-horsepower Duesenberg engines.

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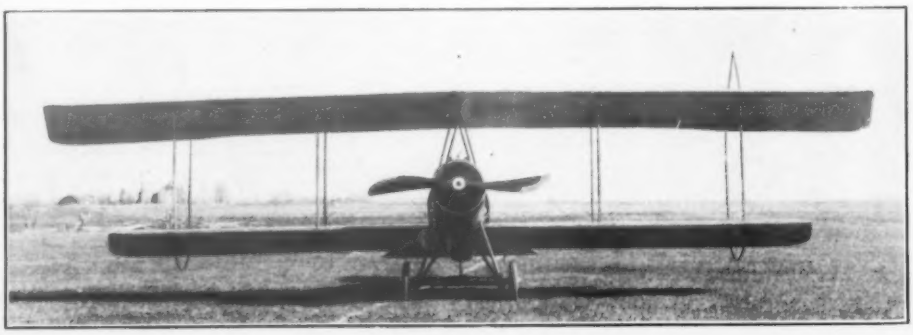
L. W. F. Engineering Company

A two-place reconnoissance tractor biplane fitted with 140-horsepower Thomas engine is being manufactured by the L.



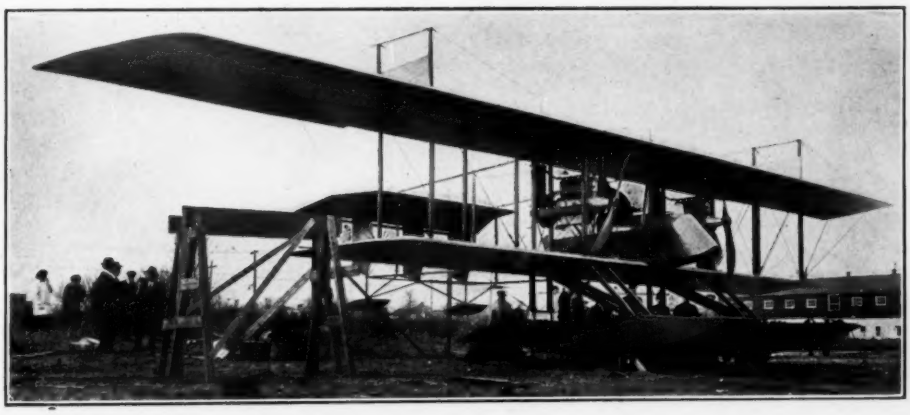
THE L. W. F. TRACTOR

W. F. Engineering Company of College Point, L. I. The officers of the company state that they have decided that it is best not to give any information at all about their plane as they are doing strictly government work and have business in sight to last for a year and could not take another order if they tried to. In recent official tests at Hempstead Plains the machine with pilot, passenger and full load made a high speed of 93.8 miles per hour and low speed of 45 miles per hour.

* * *

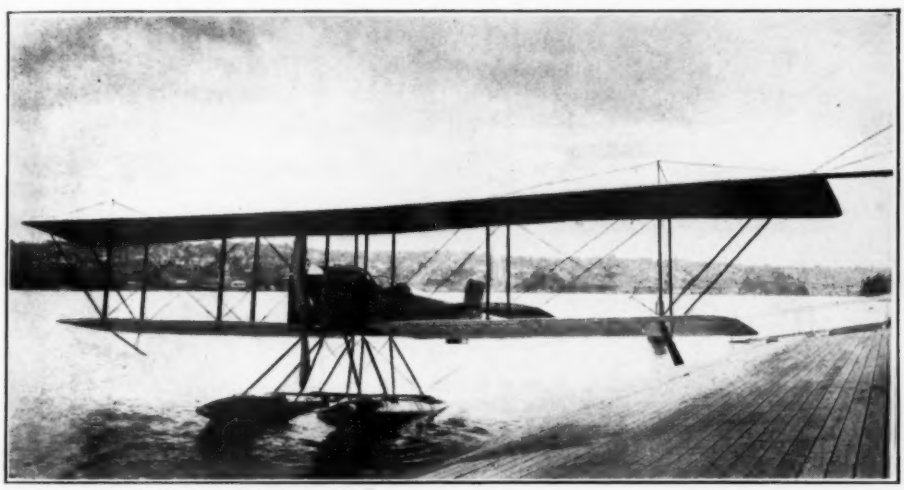
New York Aero Construction Company

The New York Aero Construction Company is developing two models of tractor biplanes at its factory, 216 High Street, Newark, N. J., from designs of Warren S. Eaton. The machines are practically identical except that one has a two-float landing gear and the other a four-wheel landing gear. They are twin-engined, using two 100-horsepower engines of 6-cylinder vertical type. The great span of these machines, 73 feet, makes them particularly noticeable. Although the airplanes, fully loaded, will weigh 4,522 pounds, they have 820 feet of supporting surface so that the wing loading will be less than 5½ pounds per square foot.



THE SEAPLANE OF THE NEW YORK AERO CONSTRUCTION CO.

of the conventional type. All control surfaces are extra large. The machine, which is a single seater, is inexpensive, due to its small size and proportionately small horsepower. Owing to its slow speed, 35 to 50 miles per hour, strongly constructed body, and the distance of the pilot's seat behind the engine the operator is unusually immune to injury in case of bad landings or other smash-ups. The machine was designed by S. S. Pierce, who was for many years instructor in the Bleriot School near Paris.



MODEL B & W OF THE PACIFIC AERO PRODUCTS CO.

Pacific Aero Products Company

Conservative development of airplanes along standard lines is being undertaken by the Pacific Aero Products Company, whose president is W. E. Boeing, of Seattle, Washington. The model which is announced to the public is a two-float triplane with 125-horsepower Hall-Scott engine and 52 feet span. Other models, it is understood, will be announced by this company shortly.

* * *

S. S. Pierce Aeroplane Company

An airplane for sportsmen is manufactured at Southampton, L. I., by the S. S. Pierce Aeroplane Company. This machine, which embodies many ideas of foreign practice, is equipped with a 40-horsepower 3-cylinder fixed radial air-cooled engine, designed by Charles L. Lawrence. Ordinary gasoline and ordinary motorcar lubricating oil are used. The body is of the monocoque type, which, while slightly heavier than the linen body, is far more efficient aerodynamically, so that the horsepower required is greatly reduced. The wing section is pecularly adapted to slow speed work and the high gap ratio makes for great efficiency. The landing chassis is

* * *

Standard Aero Corporation

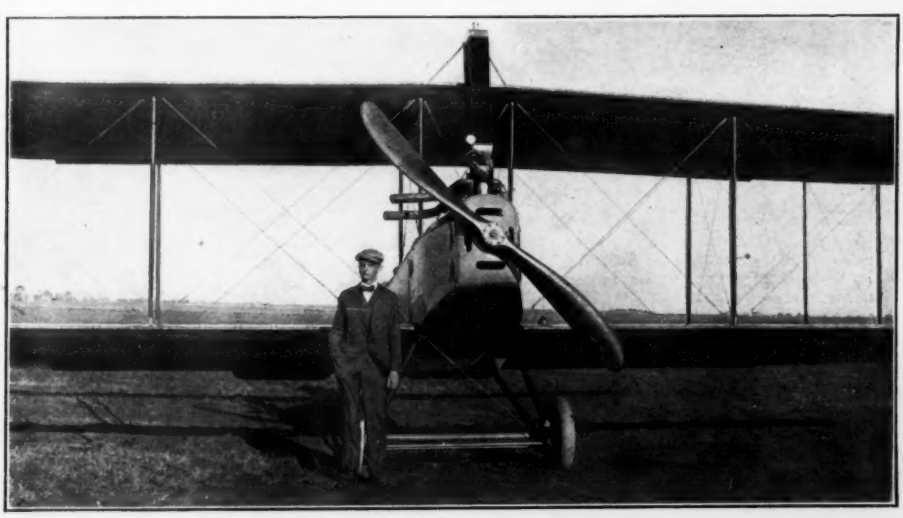
Four models of the Standard Aero Corporation airplanes are announced for 1917. These are from designs by Mr. Charles Day and include three land machines and a seaplane.

The Standard model H-3 is continued as in 1916.

The model J is a primary training machine using the R.A.F.3 wing curve with a dihedral of three degrees and a sweep back of five degrees. Special attention has been given to the factor of safety. The landing gear is of the three-wheel type with a small wheel in front to prevent nosing over in bad landings.

S. S. PIERCE'S SPORTSMAN'S BIPLANE

The specifications for the twin-engined military seaplane which is being built in large quantities by the Standard Company, appear in the table of American airplanes for 1917. Noticeable points about the machine are the two model A-5a Hall-Scott 140-horsepower engines and the weight, which, when the machine is fully loaded, exceeds two tons, about 1400 pounds being the useful load. The Standard Company is also building a speed scout of 26 feet 6 inches spread with a model A-5 125-horsepower Hall-Scott engine.



CHARLES H. DAY AND A STANDARD H-3

MODEL S-4 STURTEVANT SEAPLANE

Sturtevant Aeroplane Company

In addition to its 1916 model, the Sturtevant Aeroplane Company announces its model S-4 all steel seaplane. This machine has a steel body, ailerons, rudder, elevator, stabilizer and struts and steel wing spars. The use of steel construction has permitted the standardization in the construction of Sturtevant planes. The speed range which is claimed for this machine is from 40 to 73 miles per hour and a climb of four thousand feet in twelve minutes. It is built from designs of Grover C. Loening. Numerous other makes of machines also from Mr. Loening's design will be announced during the course of the year. A bi-plane pursuit machine is expected to be among the most interesting of the new types.

* * *

Thomas-Morse Aircraft Corporation

Several recent changes in the Thomas D-5 reconnoisance machine, which is being built for the United States Army, have been announced in the past few days.

UNITED EASTERN COMPANY BIPLANE

The original D-5 had a double over-hang, but this has been changed to a single bay over-hang. The exhaust now passes over the top plane instead of along the sides of the fuselage as formerly, and various minor changes have also been made, as shown in the accompanying photograph. The Thomas-Morse Corporation, whose factory is at Ithaca, N. Y., is also manufacturing twin-engined machines and other types for both the United States Army and Navy, and announcements of several military and naval type airplanes are expected for 1917.

* * *

United Eastern Aeroplane Corporation

The United Eastern Aeroplane Corporation, of 1251 De Kalb Avenue, Brooklyn, announces three types of airplanes for 1917, two land machines and one seaplane. All three types are tractor biplanes of conventional design. The factor of safety of 10 is claimed for all parts of all three models. The wing curve used is Eiffel No. 36. The company has recently increased its capital from $50,000 to $1,000,000 and expects to increase its facilities for the manufacture of flying machines very rapidly. The Eastern School of Aviation is owned by this company. Frederick C. Hild, who is also treasurer of the company, is in charge of the Aviation School. A small number of Bleriot type monoplanes of very high speed will also probably be built by the company in 1917.

* * *

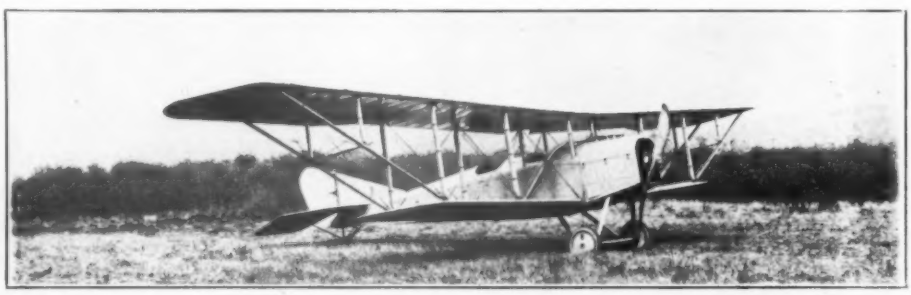
Wittemann-Lewis Aircraft Company, Inc.

The Wittemann-Lewis Aircraft Company, Inc., of Newark, N. J., is the successor of the Wittemann Brothers, of Stapleton, Staten Island, New York. The company has recently removed to a new plant at Newark on the Lincoln Highway where it crosses the Passaic River, where they have both land and water facilities for testing their machines. The new factory contains approximately 16,000 feet of floor space and is being thoroughly equipped with modern labor-saving machinery.

The officers of the company are Charles R. Wittemann, president; Samuel C. Lewis, vice-president; and Paul W. Wittemann, secretary. The Wittemann brothers have been actively engaged in designing and manufacturing and flying aircraft since 1906. Their earlier experiments were contemporaneous with the Wrights. Vice-President Samuel C. Lewis has for an extended period been employed by the French Government as a civilian instructor for officers of the French Flying Corps. He has recently returned to this country.

The Wittemann-Lewis Company are now building 2-place reconnaissance tractors, embodying the latest conventions of foreign practice, one of which they will exhibit at the Aeronautic Exposition.

They are doing experimental work on a large following plane type airplane which they expect to develop. This is said to be the first practical attempt to so dispose tandem or following planes to avoid reduction of their efficiency by the upward curve of the turbulent current set up by the preceding plane. The manufacturers assert the novel design shows a concrete and well defined effort to obtain an airplane of great weight-carrying capacity, within good engineering limits, and adheres to principles of engineering construction, elements of design and formulæ.



THE NEW THOMAS D-5

* * *

Wright-Martin Aircraft Corporation

The new Wright-Martin airplane known as the model V, is announced for the first time in connection with the Pan-American Aeronautic Exposition. It is a two place reconnaissance tractor biplane designed for long range work. The power plant consists of a Simplex model A Hispano-Suiza 8-cylinder engine. The wings have a spread of 39 feet 8½ inches, they will be staggered, and have a slight dihedral angle. The wing curve is the Vought No. 4. It is claimed to have wide speed

THE WRIGHT-MARTIN MODEL V

range and minimum motion of the center of pressure. The wing curve permits very substantial construction. Four large ailerons are hinged to the trailing edges of the wings.

The body is of the two place one piece type, flat sided and fully enclosed. The nose containing the power plant is detachable and this is one of the special features of the machine. The fuel tanks are placed behind the passenger's seat, well removed from the engine to minimize fire risk. The body is constructed of ash and spruce, braced with Roebling vanadium steel wire and Wright-Martin turn buckles. The rear cockpit is fitted with Deperdussin control and the instruments are arranged in accordance with Government requirements on the instrument board. The chassis of the two-wheel type of special design minimizes head resistance and is made of ash.

The axles are nickle steel tubing specially heat treated and the design of the landing chassis is such that repairs to the axles can be made without effecting the adjustment of the shock absorbers. About ten yards of cotton encased rubber cord is used on each shock absorber. The wheels are held in position by hexagonal hub caps and the wheel tread, five feet three and a half inches, is very broad.

MODEL V, WRIGHT-MARTIN TRACTOR

The control areas are operated through double control cables passing over pressed steel pulleys of very novel design. The loading per square foot is 5.86 pounds and the loading per brake horsepower 16.86 pounds. The Hispano-Suiza engine turns an eight foot four inches in diameter by five feet seven and a half inches pitch propeller at 1450 revolutions per minute.

The Martin model R, the reconnaissance tractor, is continued for 1917 with 140-horsepower Hall-Scott engine.

One of the features of the Wright-Martin Aircraft Corporation exhibit at the Pan-American Aeronautic Exhibition is expected to be the original Wright flier of 1903, the first power-driven airplane in the world to fly. In this machine on December 17, 1903, Wilbur and Orville Wright each made two flights. Orville Wright made the first flight and Wilbur the longest flight. The power developed by the engine in these first flights was 12 horsepower.

Lighter-than-Air Craft for 1917

It is safe to predict that great progress will be made in the developments in lighter than air craft in the United States in 1917. The United States Army has organized a lighter than air section at Fort Omaha, Neb., under Captain Charles de F. Chandler, and reports from officers who have seen the operations of these craft in Europe lead to the belief that substantial developments will be made in their construction during the coming year.

Connecticut Aircraft Company

All types of lighter-than-air craft are being designed and will be constructed by the engineers of the Connecticut Aircraft Company, New Haven, Conn. This company delivered recently the first navy dirigible DN 1 to the Pensacola Station, where it is being assembled. This dirigible is of the non-rigid type equipped with ballonets.

INDIVIDUAL SUSPENSION PATCH

The company recently received an order from the Signal Corps, U. S. A., for an observation balloon of the latest type. This craft is now complete at the company's plant at New Haven. It represents the standard foreign type with large cylindrical bag and torrus or rudder. Tail cups are used for stabilizing purposes. The balloon has a capacity of 30,000 cubic feet of hydrogen. The main gas bag is built of a double texture rubberized cotton fabric cemented and sewn in the correct shape. It is equipped with a ballonet to maintain proper gas pressure in the bag. The advantages claimed for this type of military balloon are that its design gives minimum drift and maximum lift. A criticism has been that the use of the steering rudder or torrus causes greater resistance, but aerodynamic experiments have shown that the rudder simply acts as a stabilizer and the increase in resistance is very slight.

A new individual suspension patch developed by the company has just been announced. This patch is expected to revolutionize the manner of suspending weights from all types of non-rigid balloons. The patch eliminates the use of the old type belly-band suspension. It can be placed on the surface of the balloon at any point and at any angle and it saves considerable weight. In actual test of strength one of the new patches held over 1,700 pounds.

* * *

The French American Balloon Company

The French American Balloon Company of St. Louis, Mo., is engaged at the present time in manufacturing kite balloons for the United States Government under a contract recently awarded to them. Plans and specifications for a big dirigible on Zeppelin lines are also being prepared. The company is also actively engaged in promoting a great national balloon contest for 1917.

The Goodyear Tire and Rubber Company

The Goodyear Tire and Rubber Company, of Akron, Ohio, are devoting the efforts of their organization to the production of military lighter-than-air craft. It is thought that up to the present time the importance of kite balloons has been underestimated in this country.

GOODYEAR BALLOON'S KEEL

One of the latest Goodyear products is 80 feet long and of 25,000 cubic feet capacity. The manufacturer claims that it will not shift, veer or yaw even in a stiff gale.

Airplane Engines for 1917

Perhaps the chief characteristic in airplane engine development in the last few months has been the increased use of aluminum, in order to reduce the weight of the engines per horsepower.

The new Sturtevant 5-A, eight cylinder, 140 horsepower, valve in the head, engine weighs 514 pounds against 580 pounds for the model 5, which develops the same horsepower. This is a reduction in weight of 66 pounds, so that the new engine weighs about 3.6 pounds to the horsepower.

The new Thomas model 88 develops 150 horsepower and weighs only 525 pounds, equipped with a self-starter, 105 pounds less than the 135 horsepower model 8 engine, so that the new engine weighs but 3½ pounds to the horsepower.

The new Hall-Scott A-5a, 140 horsepower, six cylinder vertical engine weighs ten pounds less than its prototype, the A-5 125 horsepower.

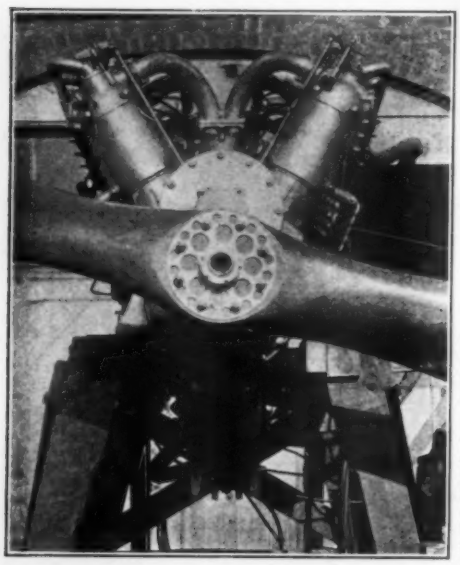
An interesting development has been the number of engines of very large horsepowers which are either ready for the market now or are in course of construction.

The Curtiss 12 cylinder 250 horsepower engine, the Duesenberg 250 horsepower engine, the General Ordnance Company, 250 horsepower engine, the twelve cylinder Packard engine, the twelve cylinder Sturtevant engine and the 300 horsepower engine which is being completed by the Knox Motor Company, should be put on the market inside of twelve months.

If one were to predict the engine development for 1917 he might guess that in another year engines from 75 to 110 horsepower which weighed between 200 and 300 pounds and engines of 300 horsepower which weighed about 900 pounds would probably be announced, while even larger horsepowers are to be expected. The development of large horsepowers should result in a reduction of weight per horsepower.

The Aeromarine Plane and Motor Company

The Aeromarine Plane and Motor Company announces two types of engines for airplanes for 1917, a six-cylinder 85 horsepower and a twelve-cylinder type. The



AEROMARINE 12-CYLINDER ENGINE

six cylinder is practically a continuation of the vertical engine of former years. The twelve cylinder is a new engine, built from new designs, and according to the manufacturers, will deliver 150 horsepower. The crankshaft is of the seven bearing type, the connecting rods are of the fork type made of chrome nickel steel, the valves are concentric, the inlet valve working inside the exhaust and both valves being set practically in the center of the cylinder head. The crank case is 92 per cent. aluminum and 8 per cent. copper. Oil is delivered to the main bearings and every part of the engine by forced feed. The design of this engine prevents overheating of the cylinders when flying upside down, or "looping the loop." Ignition is supplied by two 12-cylinder Dixie magnetos. Water cooling is used and a thermostat regulates the temperature. Two Zenith carburetors are employed. The weight of the engine complete is approximately 750 pounds.

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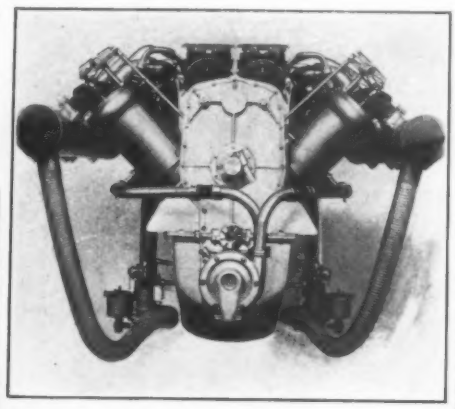
The Curtiss Aeroplane and Motor Corporation

No new types of engines for 1917 are announced by the Curtiss Corporation.

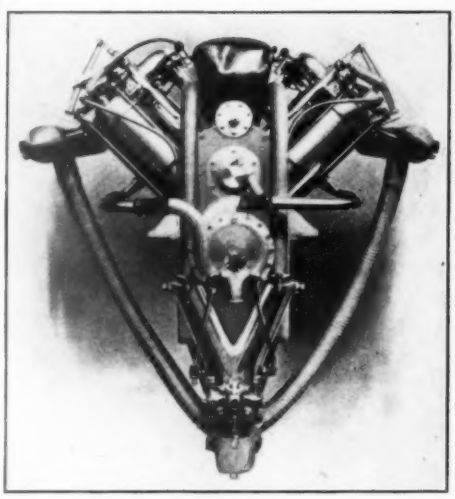


CURTISS V-2 200 HORSEPOWER

Refinement and improvements on the standard engines are being made as experience dictates. The three types for 1917 are the OX, OXX and V2. All three are eight-cylinder V, four-stroke cycle engines.

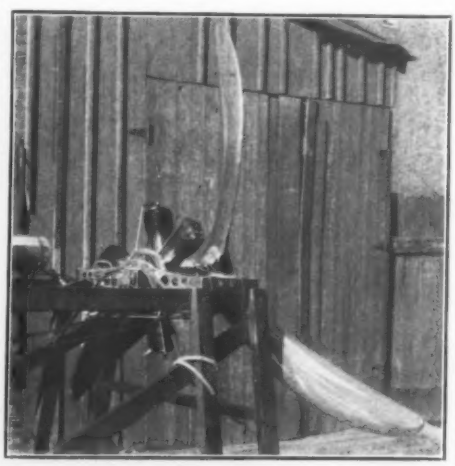
The OX is rated 90 horsepower, 1,400 revolutions per minute, and the cylinder dimensions are 4 inches bore and 5 inches stroke. The OXX, which is rated 100 horsepower, has one-quarter inch larger bore. Ignition is supplied by a single spark, 8-cylinder high tension magneto, carburetion is from duplex Zenith, and the lubrication is pressure feed with a gravity return to a splash pan and oil reservoir. The oil pressure is from 40 to 60 pounds at 1,400 revolutions per minute, water circulation by a centrifugal pump is used to cool the engine, and poppet valves in the head are employed. Chrome vanadium steel, "H" section connecting rods are used, and the rod bearings are brass backed and babbitt lined. The engine has a five bearing chrome nickel steel crank shaft.

Recent changes in the VX engine of former years have raised its rated horsepower from 160 to 200, and it is now called the V2. No radical departures



CURTISS OXX 8-CYLINDER

have been made, but mechanical alterations and improvements have increased the efficiency. Double ignition and two Zenith carburetors are used. The general design follows the lines of the OX and the OXX, except that the size is greatly increased. While the rated horsepower is 200, a maximum of 220 is obtained at 1650 revolutions per minute. The torque at 1,400 revolutions is 1,000 pounds, and at 1,650 revolutions 1,100 pounds.



BROOKE MULTI-X

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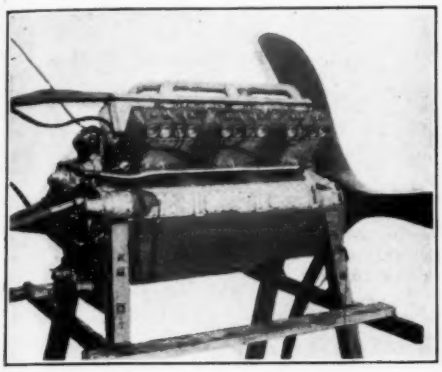
The Brooke Multi-X

Thomas Preston Brooke, of Chicago, has produced an airplane engine, which owing to foreign patent applications pending, cannot be described in detail. It is a 6-cylinder rotary engine, the cylinders being 3½ x 4 inches. According to the manufacturer, the engine has developed 78 horsepower. It is designed so that there is practically no gyroscopic effect in the revolving motor and propeller. It is asserted that this engine has a perfect four-cycle action, although it produces an explosion in each cylinder at each revolution. In the tests, an 8-foot diameter, of 6-foot pitch, 3-blade Paragon propeller was used.

Dayton Aero Motor Company

No change is announced in the specifications of the Rausenberger engine for 1917, but the Dayton Aero Motor Company, of Dayton, Ohio, which has developed the engine, announces that it has sold all its interests in the manufacture of the Rausenberger motor. At the present time it is impossible to make an announcement of the purchaser, but it is expected that the manufacture of the Rausenberger engine will go forward in 1917.



DUESENBERG 12-CYLINDER ENGINE

Duesenberg Motor Company

A twelve-cylinder airplane engine with a bore of 4⅞ inches and a stroke of 7 inches, which will deliver about 300 horsepower, is announced by the Duesenberg Motor Company, of St. Paul, Minn. Many years of experience in the building of high-class gasolene engines for motor boats has fitted the Duesenberg Company to produce engines for aircraft. Months of experiment with this new aircraft engine have refined it to a point where its reliability should be insured. No details of the construction of the engine beyond those that appear in the illustration are available. A four-cylinder aero engine is also built by the Duesenberg Motor Company and a twelve-cylinder engine of even larger horsepower than the one announced above is being developed.

* * *

General Ordnance Company

A new 8-cylinder engine, the counterpart of one built in France before the war and which developed 199 horsepower at 1,450 revolutions per minute, has just been announced by the General Ordnance Company, of Derby, Conn., from designs by Charles L. Lawrence and Francis Moulton.

The new engine, which weighs only 876 pounds, is expected to develop 230 horsepower at 1,800 revolutions per minute. It is a V type, water cooled engine with cylinders set at 90°. The bore is 4¾ inches, stroke 6½ inches, and piston displacement 920 cubic inches. The connecting rods are of I section; each rod on an opposite pair of cylinders bear on one crank pin, one rod of each pair being forked. The peculiar feature of the engine is that no bushings are used for the piston pins. The material of the pistons is used for bearing surfaces, the piston pins being clamped in the connecting rods. Another novel feature is the over-run exhaust ports at the bottom of the stroke controlled by a rotary valve turning at one-quarter engine speed. Lubrication is by forced feed under a pressure of between 50 and 100 pounds. A reduction gear is used for driving the propeller, the gear ratio to be determined by the needs of the individual user, the standard reduction being 2 to 1. Water circulation for cooling is by a centrifugal pump. Two Dixie 8-cylinder magnetos are used, driven from a spiral gear on the crank shaft through spiral gears on the magneto shaft, each magneto firing the entire engine.

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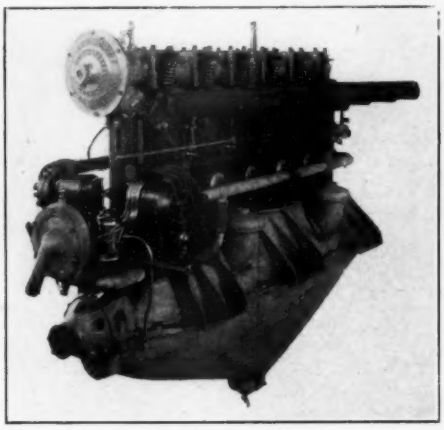
The General Vehicle Company

Rotary Gnome engines are being built to foregn specifications by the General Vehicle Company, at Long Island City, L. I. Recently the company has received



HALL-SCOTT BIG SIX

permission to sell these engines in the United States. No details of the engine, other than those stated in the table of airplane engines printed in this issue, are available, but it may be stated that reports from abroad indicate that the American made Gnome engine is giving complete satisfaction in military operations.

* * *

Gyro Motor Company

Rotary airplane engines of American design and construction are being built by the Gyro Motor Company, 774 Girard Street, Washington, D. C., in two models, "K" and "L." The "K" model is a 90 horsepower and the "L" is 110 horsepower. Practically no change in the construction of these engines has been made during the past year. Model "K" is a 7-cylinder engine and weighs 215 pounds, and the claimed gasolene consumption is 8 U. S. gallons per hour, while model "L" is a 9-cylinder engine with a gasolene consumption of 10 gallons per hour. Both are lubricated with castor oil and air cooled. The bore of both is 4½ inches, stroke 6 inches. The speed of the "K" is 1,250 revolutions, for the "L" 1,200 revolutions per minute, at which speeds they are said to develop the rated horsepower.

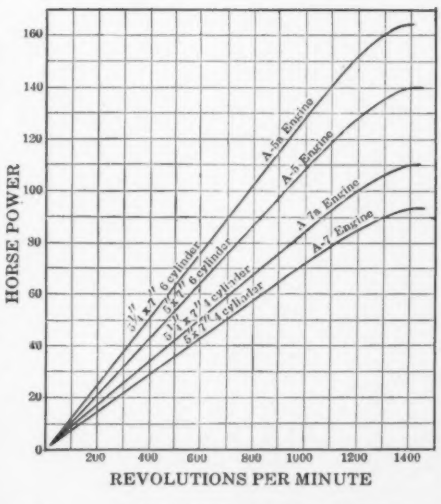


FIG 1. HALL-SCOTT POWER CURVES

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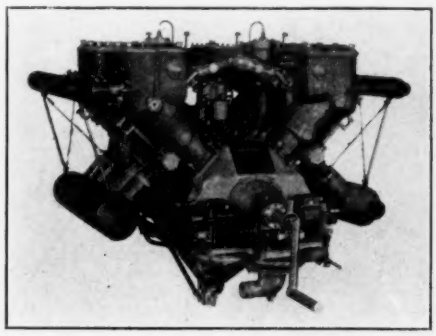
Hall-Scott Motor Car Company

Two new types of airplane engines have recently been announced by the Hall-Scott Motor Car Company of Berkeley, Cal., the type A-5a, six-cylinder 140 horsepower,



GENERAL ORDNANCE CO. ENGINE

and type A-7a, four-cylinder 100 horsepower. The new types are practically similar in design to the well known types A-5 and A-7, respectively, except that whereas the older types had cylinders of 5 inches bore by 7 inches stroke the new engines have 5¼ inches bore while the stroke remains the same.

The principles of the standard Hall-Scott types are so well known in the American aeronautical industry that descriptions of the new engines are almost unnecessary. The simplicity, accessibility and sturdiness of these engines are well known, and the claims of the company that the four and six-cylinder models of gasolene engines are better fitted for aeronautical work than eight and twelve cylinder engines of equal horsepower, because they can be built more sturdily are also familiar to everyone connected with American aeronautics.

In all four types fully water-jacketed cylinders are cast separately. The connecting rods are of I-beam cross-section, milled from solid chrome nickel steel. Zenith carburetion is provided. Self-starters can easily be fitted to Hall-Scott engines, and these engines have given satisfactory results when used in testing self-starters. Two water-proofed Dixie magnetos fire the gasolene charges, each cylinder being fired by two sets of spark plugs. Water circulation is used for cooling purposes. Extremely large overhead valves, located in the head and operated by rocker-arms, are designed to give quick opening and to allow the gases to enter and exhaust with minimum interference.

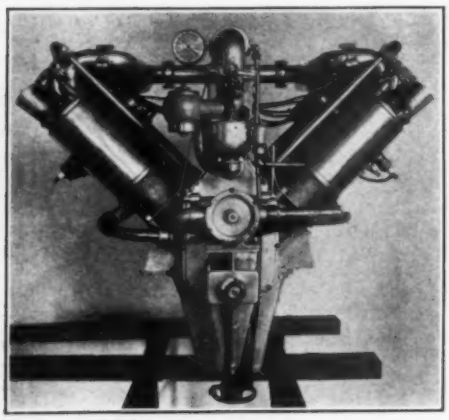
Through refinements in design it is provided that the weight of the A-5a and A-5 and the weight of the A-7a and A-7 engines are practically equal, though the A-5a is rated at 140 horsepower as against 125 for the A-5, and the A-7a is rated at 100 horsepower as against 90 for the A-7.

The Hall-Scott factory is turning out fifteen engines a day on contracts for the United States Army and Navy and for foreign governments.

The power curves of the four types of engines are shown in the accompanying diagram (Fig. 1). The diagram shows that at 1,375 revolutions per minute, the normal propeller speed, all of the models exceed their rated horsepower.

Kemp Machine Works

Four types of airplane engines—all of them air-cooled—are offered to the public by the Kemp Machine Works, Muncie, Ind. These engines are rated at 16, 35, 55 and 80 horsepower. The 16 horsepower model has two cylinders, the 35 horsepower model four, the 55 horsepower six and the 80 horsepower eight. The construction of the eight-cylinder 80 horsepower air-cooled airplane engine is especially interesting. It is claimed that the adoption of air-cooling is lighter than the usual water-cooling for airplane engines of the fixed V-type. Also the radiator is done away with, and in this way head resistance is saved. In faster airplanes head resistance is an all-important factor as the pressure per square foot is 12.3 pounds at fifty miles per hour, 27.7 pounds at seventy-five miles per hour, and 49.2 pounds at one hundred miles an hour. The radiator of a water-cooled engine



ORLO 8-CYLINDER

must be placed in a position exposed to the air, and is generally in the slip-stream of the propeller, which increases the resistance from 15 to 25 per cent. The saving is not only one of weight, but is more than equally important in head resistance.

The engine is cooled by a positive forced draft cooling system, in which the fan is mounted direct on the crank-shaft and discharges the air direct into the two manifolds leading to the cylinder jackets.

The cylinders of all the makes of engines are 4¼ x 4½ inches, except the eight-cylinder model, which is 4¼ x 4¾ inches. It develops its rated horsepower at 1,150 revolutions per minute. The weight completely equipped is 380 pounds.

* * *

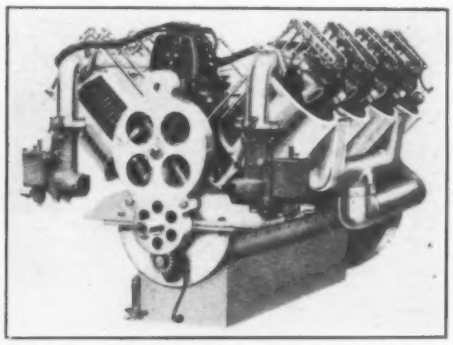
Knox Motors Company

A heavy duty 300 horsepower twelve-cylinder engine for airplanes is offered to the public for 1917 by the Knox Motors Company of Springfield, Mass. The engine has been developed from the designs and under the personal direction of Frank Trego. It is extremely substantial and is the result of thorough tests and careful engineering design. Some of its notable features are that it is supported in the body on a shelf running the full length of the case instead of the usual supporting legs. The twelve cylinders are cast three to a block and the cylinder heads are cast in blocks of six. The crank-shaft is a chrome nickel forging drilled for pressure lubrication and is of the three-bearing type. The oil pump hangs from the upper half of the crank case, a patented feature, so there are no tight connections between the pump and the engine. Ignition for starting is furnished by battery and for running by a generator, making at all times a dual source of crank supply. Double Zenith carburetors are used.

* * *

Maximotor Company

No changes are announced in the products of the Maximotor Company, 1546 East Jefferson Avenue, Detroit, Mich. The



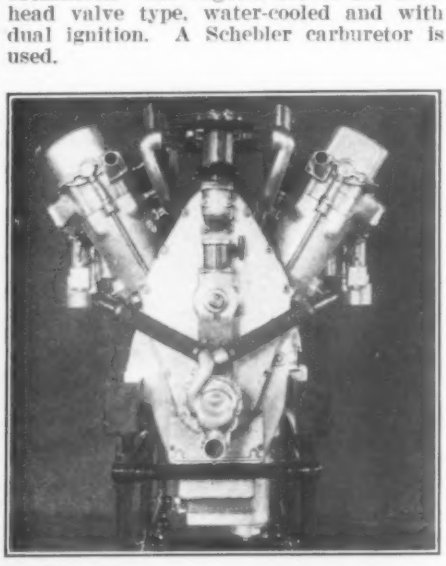
KEMP 8-CYLINDER

three models—A-6, B-6 and A-8 will be continued as in previous years. The A-6 engine is an 80-90 horsepower at 1,600 revolutions per minute, with six 4½ x 6-inch cylinders. The B-6 is a six-cylinder engine, develops from 110 to 120 horsepower, and has 5 x 6-inch cylinders. The cylinders in the A-8 are 4½ x 5 inches and from 110 to 120 horsepower is claimed at 1,600 revolutions per minute.

* * *

The Orlo Motor Company

Three types of aerial engines manufactured by the Orlo Motor Company, 39 Graham Street, Rochester, N. Y., are continued in 1917 as in 1916. They include a four, a six and an eight-cylinder model of the V-type. The cylinders on all models are 4½ x 6 inches. The horsepower at 1,300 revolutions per minute of the four-cylinder engine is 50, of the six-cylinder 75, and of the eight-cylinder 100. One hundred and twenty-five horsepower is claimed for the eight-cylinder engine at 1,400 revolutions per minute and even higher engine speeds are said to be easily obtainable. The engines are of the overhead valve type, water-cooled and with dual ignition. A Schebler carburetor is used.



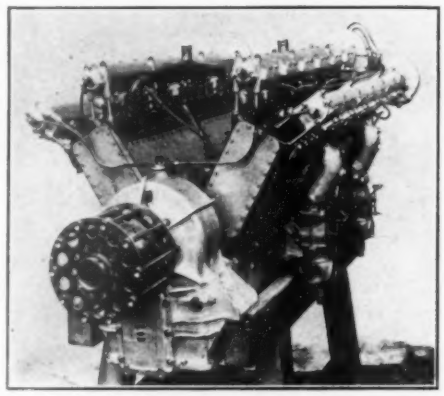
KNOX 300-HORSEPOWER ENGINE

The cylinders in the V-type engine are not staggered, but the connecting rods are set so that one rod bears directly on the crank pin while the other oscillates upon it. Water and gas manifolds are so designed that any one cylinder can be removed without disturbing the rest of the engines. Large sized nickel steel valves with separate rocker-arms and push rods for intake and exhaust are employed, no valve cages being used. The cylinders are not fastened to the crank case, but are tied to the crank-shaft itself by steel studs that extend clear through the aluminum crank case to the main bearings, which are manganese bronze, babbit lined. The engine is equipped with a device for raising all the exhaust valves simultaneously to facilitate starting.

* * *

Packard Motor Company

After years of successful experience in the automobile field, the Packard Motor Company, Detroit, Mich., announced last spring that it was preparing to enter the field of building engines for aviation. However, the policy of the Packard Company from its first organization has always been to make no announcements of engines until they were ready to be placed on the market. It is therefore impossible to add any descrtpion to that contained in the table of engines for 1917.



STERLING SUNBEAM ENGINE

The Sterling Engine Company

The Sterling Engine Company of Buffalo, N. Y., manufacturers of marine engines, are building Sunbeam airplane engines from the original design of Louis Coatalen. These engines are being built under the formulæ, patents and specifications of the Sunbeam Company, and the Sterling Engine Company has the sole manufacturing rights for this country.

The 320 horsepower Sterling-Sunbeam twelve-cylinder airplane engine is at present under construction by the Sterling Engine Company. These engines have a bore of 4 5-16 inches, stroke 6¼ inches, and are rated 320 horsepower at 2,000 revolutions per minute. Weight of the engine with carburetors and ignition but empty is 1,100 pounds. The construction of the engine is simple and the material used throughout is of the very best.

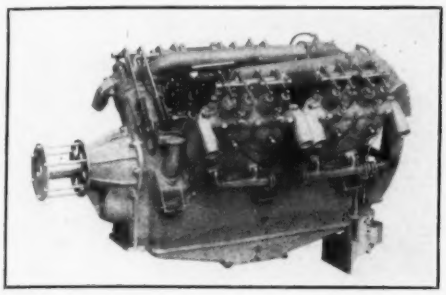
These engines are built to give an unusual amount of service and reliability. Crank case and oil pan are of special aero metal, strongly ribbed bearing hangers between each crank throw stiffens the crank case, making it rigid and preserving proper alignment of all parts. The crank shaft has eight main bearings. There is also an additional bearing supporting the propeller end outside of the reduction gear driving propeller shaft. This construction prevents deflection of the shaft and insures maximum efficiency of gearing.

Pressure feed oiling system is used so that all parts, where there is friction, are thoroughly lubricated regardless of the angle of the engine. Four carburetors are used, one for each block of three cyl-

inders. There are also four six-cylinder magnetos.

Reduction drive to propeller shaft has a two to one ratio operating propeller at 1,000 revolutions per minute with engine turning 2,000 revolutions per minute. Roller radial bearings and double thrust bearing provide ample bearing capacity for propeller load. The double thrust makes the engine suitable for both tractor and pusher type airplanes. Starting is either by air or geared hand starting from the side of the engine.

In addition to the engine described above, the Sterling Company will build a smaller twelve-cylinder Sterling-Sunbeam engine and an eighteen-cylinder V-type Sterling-Sunbeam of the same cylinder dimensions as the twelve-cylinder 320 horsepower engine.

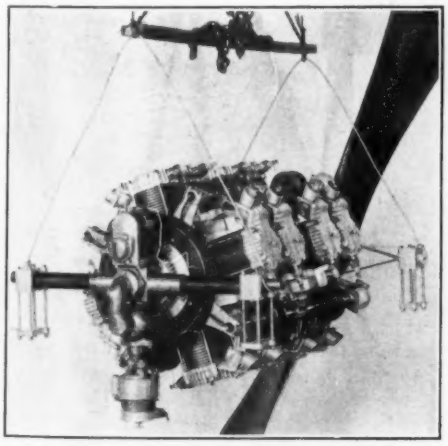


STURTEVANT 5A 8-CYLINDER

B. F. Sturtevant Company

The latest design of aeronautical engine manufactured by the B. F. Sturtevant Company, Hyde Park, Mass., is known as model 5-A type 8. The horsepower rating is 140 at 2,000 revolutions per minute and the weight per brake horsepower has been reduced to 3.7 pounds as a result of the use of aluminum. The new Sturtevant engine is of the valve in the head type and the valves are constructed of hard tungsten steel. The connecting rods are of the "H" section type and are made from forgings of a special chrome nickel steel, which is claimed to have a tensile strength of 200 pounds per square inch. The hollow crank shaft is 2½ inches in diameter and is of the three bearing type.

The propeller shaft is carried on two large annular ball bearings and is driven



H. L. F. TREBERT ENGINE

by spur reduction gears. An important feature in this engine is illustrated by the cam shaft, as the shape of the cams has been modified in order to give a quicker opening for higher power at high speeds. Lubrication is provided by forced circulation. The carburetor is of the Zenith duplex type. The most notable departures from standard Sturtevant practice exemplified in this engine are to be found in the use of the new type cam shaft and the use of aluminum resulting in great weight reduction.

* * *

Thomas-Morse Aircraft Corporation

Coincident with the Pan-American Aeronautic Exposition, the Thomas Company announces that it is ready to offer to the public its new aluminum engine as well as the Thomas model 8 engine of 1916. The full and complete description of the Thomas model 88 aluminum engine will appear in an early issue of AVIATION AND AERONAUTICAL ENGINEERING. The weight of the engine, which in its general characteristics follows the design of the Thomas model 8, has been reduced 105 pounds from 630 to 525. The horsepower has been increased from 135 horsepower at 2,000 revolutions per minute in the model 8 to 150 horsepower at 2,100 revolutions in the model 88. This increase in horsepower is largely due to an increase in the bore of the engine from four inches to four and one-eighth inches and the use of aluminum pistons permitting higher engine speed. The installation of the Thomas model 8 is shown in the accompanying photograph.

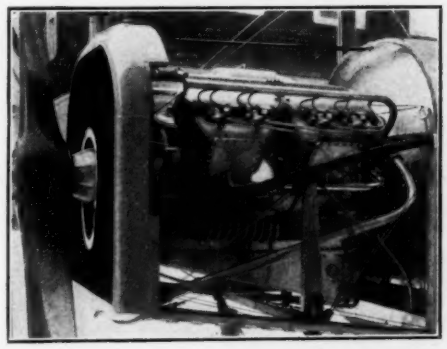
NEW COMPANY FORMED

Confirming rumors that have been current for the past month, it is announced that a new company, which will be known as the Thomas-Morse Aircraft Corporation, headed by Frank L. Morse, will take over the assets of both the Thomas Bros. Aeroplane Company and the Thomas Aeromotor Company. The organizations of the retiring companies will be retained under the personal direction of Mr. Morse, who is well known in engineering and manufacturing circles generally, where the Morse Rocker Joint Silent Chain is extensively used for power transmission and cam-shaft drives for automobile motors. William T. Thomas, formerly the president of the Thomas Companies will occupy the position of Vice-President of the new company, and B. Douglas Thomas will continue as Chief Engineer in the department of airplane design. Jerome A. Fried, General Manager of the Aeromotor Company in the past, will act as Secretary and Treasurer. Raymond Ware, who was formerly in charge of sales of both airplanes and aero-engines will continue in this capacity and also have general supervision of the advertising. The personnel of the Engine Department, which will shortly move into a new and spacious concrete steel factory, remains the same. Harold N. Bliss will be in charge of manufacturing and George H. Abel will continue as chief engineer and have oversight of all experimental work. Much of the success that has attended the Thomas 135-horsepower aeromotor, now well known to aeroplane manufacturers, is due to these two men, who combine experience covering more than eight years in the development of high-speed aeronautical engines. With the increased facilities offered by the new aeromotor factory, production will be materially increased.

* * *

H. L. F. Trebert Engine Works

An airplane engine of novel design providing sixteen air-cooled cylinders cast separately and arranged radially about the crank-shaft is announced by the H. L. F. Trebert Engine Works, 495 St. Paul Street, Rochester, N. Y. The engine revolves on a stationary crank-shaft with double row annular and thrust ball-bearing. No connecting rods are used. Two pistons are in one piece with a yoke in the center having a sliding bearing which takes the place of the connecting rods and gives the same action with less weight. The gases are drawn through the end of the crank-shaft which acts as part of the manifold, as the carburetor is attached to the end of the shaft. Passing through the crank-shaft and through the web of the crank into the main manifold, the gases are then distributed into the underside of the piston, from thence through the automatic valves in the piston head into the cylinder. The ignition is a two-spark magneto running at twice engine speed. Lubrication is a continuous flow through the crank-shaft. The chief advantages claimed for the Trebert engine are freedom from vibra-



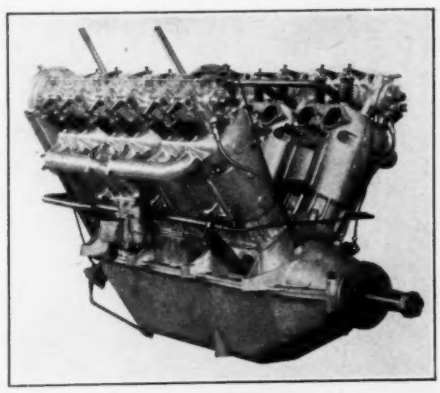
THE THOMAS MODEL 8 ENGINE

tion, lightness, durability, compactness, accessibility, simplicity and almost complete absence of gyroscopic action.

* * *

Wisconsin Motor Manufacturing Company

Two models of aviation engines are announced for 1917 by the Wisconsin Motor Manufacturing Company, Milwaukee, Wis., a six-cylinder 140-horsepower, and a twelve-cylinder 275-horsepower. Both models use 5 x 6½-inch cylinders. The most notable feature of these engines is the size of the valves, which are three inches in diameter. The cylinders are made of aluminum alloy. The cam shaft drive in the twelve-cylinder model is through spur gears, in the six-cylinder model through bevel gears. This feature



WISCONSIN 12-CYLINDER

is the main difference in design between the six and the twelve-cylinder engines. The crank case is made of aluminum, the crank-shaft of chrome vanadium steel, and this material is also used in the tubular connecting rod. The pistons are made of aluminum alloy and weigh only two pounds, two ounces each.

The water circulation is by a cylin-

drical pump. The lubricating system is one of the main features of the engines, being designed to work at any angle. No splash is used in the crank case, the system being full-forced feed. Ignition is by two Bosch magnetos, each one firing the entire engine. The Zenith duplex carburetor is used and two Zenith duplex carburetors are used in the twelve-cylinder engine. The engines are notable for their accessibility. The many years of experience which the Wisconsin Motor Manufacturing Company has had in building marine, automobile and racing gasolene engines have been a distinct advantage in the development of the V 6 and V 12 airplanes models. The engineers of the company, in developing these models, have also given close attention to standard foreign practice.

* * *

World's Motor Corporation

A two-cycle rotary engine of 70 horsepower of 5 cylinder 4.5 inches bore by 4¾ inches stroke which develops its rated horsepower at 1000 revolutions, called the Frederickson engine, is being built by the World's Motor Corporation of Bloomington, Ill. The officers of the Company are anxious to have airplane manufacturers examine this engine very carefully as it is said to embody many principles in design that are absolutely new.

* * *

Wright-Martin Aircraft Corporation

Mr. Henry Crane, of the Crane Simplex Motor Car Company, brought back from Europe about a year ago plans and specifications of the Hispano-Suiza eight-cylinder water-cooled aircraft engine, which has proven highly successful in the French aviation service, and which is still considered the best 150-horsepower engine that the Allies are using in their air service today. The Wright-Martin Corporation, which owns all of the stock of the Crane Simplex Motor Car Company, has a contract for at least 450 of these Hispano-Suiza engines to be sold to the Allies, and the engines are being built in the company's plant at New Brunswick, N. J.

Few details in regard to the engine are available for publication. It is of the eight-cylinder, water-cooled V type, the low weight and high power being maintained through careful manufacturing rather than by any radical departure from standard airplane engine design. The tolerances permitted in the manufacture of this engine are extremely small and nearly all parts are machined and fitted so that gaskets are practically done away with.

The Hispano-Suiza was originally built in Spain, where the chairman of the board of directors of the company is His Majesty Alphonso XIII. Many improvements in the engine as originally put out have been made so that the product being manufactured at New Brunswick differs considerably from the early engines which were first built in Spain. In the early engines a combination of air and water cooling was used and the cylinders were fitted with nine cooling flanges each. The new engine is water-cooled throughout.

One of the engines built at the New Brunswick plant has recently been installed in an airplane designed by Chauncey Vought, of the Wright-Martin Aircraft Corporation, and the plane has been satisfactorily demonstrated at Dayton, Ohio. Deliveries of these engines to the Allies are expected to commence in the near future.

Airplane Accessories for 1917

The fact that more than forty-five concerns are represented in the following list of accessory makers shows at a glance the progress that is being made in American aeronautics. This showing is even more impressive when it is realized that many of these concerns have been for years interested in manufacturing automobile accessories. It shows that companies of large capital which are doing record businesses already realize the future of the industry. The accessories described cover every angle of the field and their utilization will make for greater efficiency, comfort and safety in aviation.

The Abercrombie & Fitch Company

The Abercrombie & Fitch Company is showing a new line of aero clothing designed and for sale by them exclusively.

The United States Government has placed a large order with the Abercrombie & Fitch Company for immediate delivery. The costume is entirely made of leather, coat has detachable fleece lining, is belted and has large bellowed pockets lined with very heavy duck; trousers are full and roomy and thong-tied at bottom — all made with patent fastenings.

Aviator Suit

This company is also showing an all-rubber seaplane costume—all in one piece of rubber sheeting, all seams steam vulcanized. There is a belt at waist and removable straps at trouser knees.

The above suit is used with leather helmet. The helmet has small reefing straps and an adjustable cape. With goggles, the face in this way can be completely protected. The gloves worn are long woolen gauntlets, with short pull-over gloves.

The Abercrombie & Fitch Company will have an extensive exhibit at the Aeronautical Exposition, and will show complete models of practical leather clothing, the new model as adopted by the United States Government, and all the accessories necessary to cover the entire field.

The new Abercrombie & Fitch Company building, now nearly completed, at Forty-fifth Street and Madison Avenue, New York, will contain a department devoted exclusively to aviators.

* * *

Acieral Company of America

A metal which it is claimed combines the strength of steel with the lightness of aluminum is manufactured under the name Acieral by the Acieral Company of America, 26 Cortlandt Street, New York. It is furnished in ingots, castings, plates, rods, wires and tubes. The texture when fractured is similar to the best steel while the specific gravity is only 2.82. Other specifications of Acieral are as follows: Melting point, 1382 degrees Fahrenheit; coefficient of linear expansion, 0.0000153; sonorousness, bell metal; conductivity, good when made for electrical purposes; hardness in casting, 119 Brinnel or 45 scleroscope; tensile strength in castings, 30,000 pounds per square inch with elongation of from 0.5 to 5 per cent; tensile strength in rods and sheets, from 28,000 to 64,000 pounds per square inch, when tempered, over 72,000 pounds per square inch; elastic limit, from 35 to 75 per cent of the ultimate tensile strength; elongation, from 5 to 25 per cent according to specification; reduction of area, from 10 to 35 per cent according to specification.

* * *

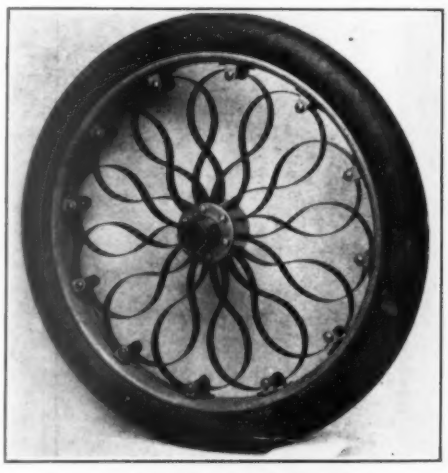
Ackerman Wheel Company

The manufacture of resilient steel wheels for airplanes has been undertaken by the Ackerman Wheel Company of Cleveland, Ohio. In recent tests, a wheel made for a thousand-pound airplane was attached to a large case loaded with 1500 pounds of sand. The side thrust blow calculated to give the wheel a stress of 27,000 pounds was applied and the wheel bore up without apparent injury. The construction of the wheel is shown in the accompanying cut.

* * *

American Bronze Company

In view of the popularity of V type engines for airplane use, aviators and aeronautical engineers will no doubt be interested in a new adjustable crank pin bearing, put out by John W. Watson, president of the American Bronze Company of Berwyn, Pa. This bearing represents a radical departure from the types of bearing now in use in that by simply dropping the lower half of the crank case, crank pin bearing wear can be taken up as simply as in an ordinary 4-cylinder engine without disturbing in any way the adjustment of the oscillating or forked rod.



Ackerman Resilient Wheel

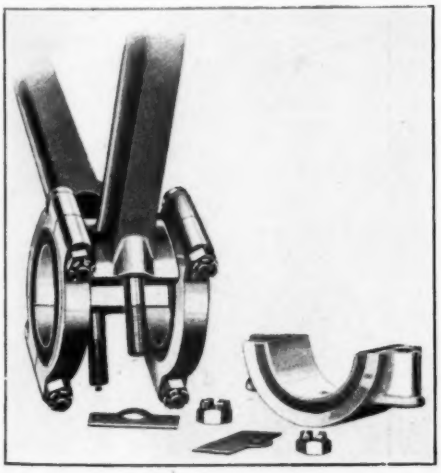
This new type of construction, because

it provides full crank pin bearing area for each small cylinder will make possible a greatly extended life for the crank pin bearings of V-type engines. The Minerva Motors Company, originally of Antwerp, Belgium, and now temporarily located at Amsterdam, Holland, is negotiating to adopt this bearing.

* * *

American Radio and Research Corporation

A powerful radio set for use of airplanes, which has peculiar features, has been developed by the American Radio and Research Corporation, Tufts College, Mass. The generator is driven by an aero fan directly attached, the entire unit being enclosed in a stream-lined casing. The radio apparatus is contained



THE WATSON BEARING

in a second unit suspended in the body. The antennæ system consists of a single 250 foot wire counterpoised by all metal parts of the airplane. The 250 feet is wound on an automatic reel which enables the observer to unwind it for sending and reel it back with minimum difficulty. The end of the wire is fastened to a streamlined bob which prevents the wire from twisting and keeps it head on to the wind. The apparatus is operative on any machine traveling between 50 and 80 miles an hour and a transmitting range of 100 miles is claimed for it.

* * *

American Vanadium Company

The necessity of employing only the highest grade products in the manufacture of airplanes has led to the increasing use of vanadium steel. The production of vanadium steel in 1913 was about 90,000 tons and in 1915 approximately 450,000 tons and in 1916, 800,000 tons. It is generally used in the manufacture of instruments of war, in which nothing but the mest is good enough. Vanadium steel is made by the American Vanadium Company, Pittsburgh, Pa. In 1911 the Roberts Motor Manufacturing Company brought out a 4-throw vanadium steel crankshaft of only 18 pounds weight for a 65 horsepower engine. The Sturtevant Aeroplane Company has taken full advantage of vanadium steel in manufacturing its all steel airplanes. The Davis non-recoil airplane gun, manufactured by the General Ordnance Company of Derby, Conn., also contains a considerable quantity of vanadium steel.

* * *

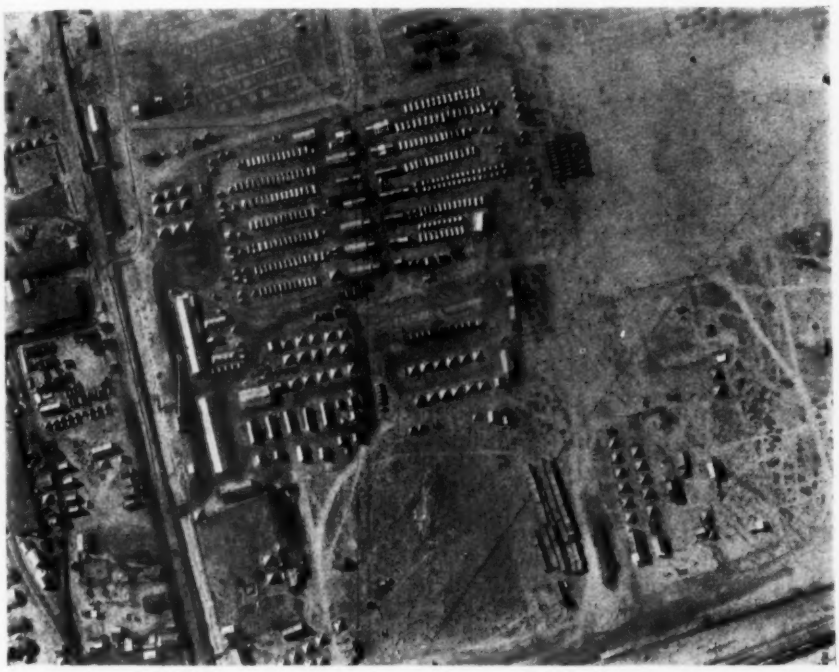
Beam Aeroplane Company and School of Aviation

The Beam School of Aviation has been in operation since November 1, 1916, using a Thomas Model E pusher airplane equipped with a 90-100 horsepower Austro-Damlier engine. The field, located at Celina, Ohio, is large, clear and level, and in the winter time an ice field of 17,500 acres can be used. An average of 150 minutes instruction a day is being maintained, and every effort is being made to make the instruction as rapid as possible. As an inducement the best student in each class of ten is presented with an airplane valued at about $600 all ready to have its engine installed. The instructors are Billie Brock and Monte Rolfe. The company intends manufacturing airplanes in the near future.

* * *

Arthur Brock, Jr.

The most important military service of the airplane is that which it performs in securing information. Experience in Europe has shown that the most reliable information which airplanes can secure is obtained photographically. Airplane cameras in use by the United States Government are manufactured by Arthur Brock, Jr., 131 South Fourth St., Philadelphia, Pa. These cameras take photographs on a scale sufficiently large to permit of the closest possible identification of gun positions, entrenchments, shell holes, trenches, etc.



THE CAMP AT COLUMBUS, N. M., PHOTOGRAPHED WITH A BROCK CAMERA

The great altitude in which airplanes are compelled to operate has enforced the use of long focal distances. The use of such focal lengths was rendered difficult by the vibrations which necessitated very fast shutter speeds. Various shock absorbing attachments are now used to overcome vibration difficulties. Until recently the average scale of military photographs was about 1/5000 actual size which is the scale of a true horizontal photograph with a twelve-inch lens at 5,000 feet. Recently larger scales have been introduced in order to show the necessary details of the terrain, and in many instances photographs are taken at a scale of from 1/1500.

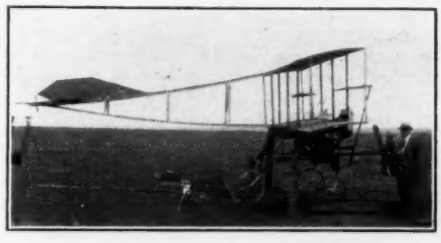
One of the great difficulties in military photography is the result of the fact that non-actinic colors, greens and yellows, will not register upon the ordinary negative emulsions. Ortho-chromatic emulsions, though somewhat slower, are used. Ray-filters are hard to use with the slower emulsions and yet near the ocean they are indispensable. Shutter speeds, therefore, present a considerable obstacle to ortho-chromatic aeronautical photography.

A camera has been perfected for the Aviation Section of the Signal Corps which makes it possible: First: To make any photographic series into a plan view map. Second: To show relative elevations of the ground positions when desired in any photographic flight. Third: To print any photographic series into a photographic map. The scale will ordinarily be made in ranges from 1/2500 to 1/5000, but larger scales can be used. Photographs are taken in the 4 x 5 size. A single flight may result in the production of more than 2000 negatives.

* * *

The Buck Automatic Aerial Torpedo Company

An ingenious contrivance making use of the principles of the standard heavier-than-air machines is manufactured by The Buck Automatic Aerial Torpedo Company, Denver, Col. A small airplane equipped with a special stabilizing apparatus carrying no pilot, but carrying a torpedo and equipped with two 18 horsepower engines is launched from a track and will travel in a straight line for a distance of several miles. The airplane is launched by a compressed air catapult designed to give the torpedo its initial velocity. The torpedo is released from the airplane by an especially designed timing device after it has traveled its predetermined distance. The torpedo is also equipped with the timing device to explode it at any given time after it is released from the plane.



DR. BUCK'S TORPEDO

A 20392

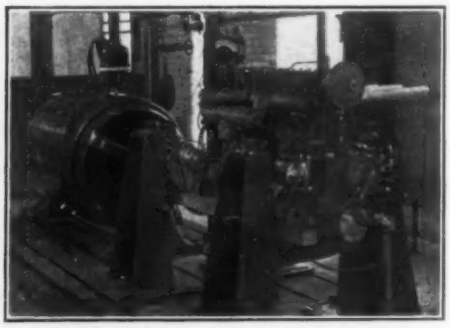
Champion Ignition Company

A spark plug specially designed for aviation engines is being developed by the Champion Ignition Company of Flint, Mich. This plug is the result of extensive tests made in the plants of the Simplex and Curtiss companies, and when placed on the market should give efficient service for an indefinite period of time.

* * *

Chelsea Clock Company

An accurate time piece is an indispensable part of the equipment of every airplane, which is to be used in cross-country flying or military flying of any kind, as it is imperative that the aviator be able to report at what time any movement of troops or other military operations were observed, and in cross-country flying navigation is entirely by dead reckoning. A high-grade clock for airplane service which is installed on many machines is manufactured by the Chelsea Clock Company, 16 State Street, Boston,



Interior of Delco Experimental Laboratory Showing Sprague Dynamometer

Mass. This company furnishes two different models of standard designs for airplanes as well as an electric clock which can also be installed.

* * *

Chemical Products Company

Modern methods of coating airplane wings date back but six years, when the first experiments along these lines were made in Germany. There is practically unanimity of opinion as to what constitutes a good wing coating. It must be smooth, it must adhere well to the cloth, it should be waterproof and unaffected by gasoline or oil. Two materials meet these requirements, cellulose nitrate and cellulose acetate.

The Chemical Products Company, 93 Broad street, Boston, Mass., manufacture a cellulose acetate dope or wing covering, which is claimed to have distinctive advantages because of its fire resisting qualities. If a lighted match be applied to the 1-B or 101-N dope of the Chemical Products Company on linen, the fabric is not ignited until the coating is melted or charred away. A red hot iron may be held against linen or cotton coated with either of these dopes without a fire, but linens or cotton treated with cellulose nitrate ignite immediately under either of these treatments.

Besides the No. 1-B and 101-N dopes, the Chemical Products Company manufactures No. 24, which is a finished coating specially designed to remove the white spots caused by the application of earlier coats. The Chemical Products Company is also prepared to produce special dope in its laboratory to meet the unusual needs of any manufacturer to whom the standard products may not be satisfactory.

Christensen Engineering Company

A scientific self-starter for airplanes in use on many standard machines is manufactured by the Christensen Engineering Company, Milwaukee, Wis. It comprises a small air compressor with clutch, an automatic carburetor capable of converting the compressed air into gasolene gas, with the proper mixture, under a pressure above that of the atmosphere, an automatic distributor, an air reservoir and a control valve. It starts the engine in its natural cycle. A gasolene engine uses about one part of gasolene to 1300 parts of ordinary air. This air and gasolene vapor is compressed and explodes in the cylinders to make the engine run. When standing still, the engine cannot produce combustions and explosions. The Christensen starter performs the function of furnishing this mixture of gasolene vapor and air to the engine and the explosion of the gas starts the engine as soon as it enters the cylinders. The Christensen starter is therefore not properly a compressed air or electric cranking device but a scientific instrument which artificially supplies the gasolene engine the mixture on which the engine operates.

* * *

Dayton Engineering Laboratories Company

The Dayton Engineering Laboratories Company, manufacturers of the famous "Delco" Ignition, Lighting and Starting equipment, have turned their eyes towards aeronautics. Various officials of the Dayton Engineering Laboratories Company have taken a lively interest in Orville Wright's pioneer experiments and in the development carried on by others in the industry.

So interested have the Delco people become in Aviation that they have established what might almost be described as a clinic on Aviation at their Dayton plant. They have built a big room in which the temperature can be controlled from summer heat to zero, and in this room they have tested aeronautical motors and have experimented with various types of ignition equipment. These experiments have been carried further by making actual flying tests with the equipment so evolved.

The Delco people admit they have little to offer the industry in complete ignition equipment at this time. They realize the really big problems that confront the engine builders to obtain efficient ignition. The Delco people simply are ready, willing and eager to meet the industry and plan with it in developing an ignition system that does the work required of it.

At the Exposition to be held at the Grand Central Palace, February 8 to 15, the Dayton Engineering Laboratories Company will have an exhibit consisting of various types of ignition, starting, and lighting systems for aeroplane engines. A corps of experts will be in attendance.

Howard Reinhart, the aviator, has recently formed a connection with the Dayton Engineering Laboratories Company.

* * *

Ernest H. DuVivier

Recording gauges of all kinds have been manufactured for many years by Jules Richard, 25 Rue Melingue, Paris. Ernest H. DuVivier, 30 Church street, New York, is the American agent. Barographs, recording and dial tachometers, gasoline and oil gauges, recording thermometers, altimeters, statoscopes, instruments for measuring wind velocity, monometers, for measuring gas pressure in lighter-than-air craft, and airplane cameras are manufactured by Richard.

The Electric Storage Battery Company

The Exide battery has, for several years, been successfully used on airplanes as a part of the standard equipment of the Sperry Automatic Pilot. This battery normally floats across the generator that supplies current for operating the control equipment of the stabilizer. The battery is, accordingly, always fully charged and ready to operate the control equipment should the generator fail.

The Electric Storage Battery Company of Philadelphia is bringing out a new battery for use with the Sperry Auto-

Fig. 1. A Three Cell Exide Battery Showing Unit Cell Construction and the Saving in Weight and Space in the Cover Construction

matic Pilot which will be on exhibition in the Sperry Gyroscope Company's booth at the Pan-American Aeronautical Exposition. This battery is specially designed for airplane service. With an increase of only 7 pounds in weight it will be three times the capacity of the battery formerly used and will, at the same time, be constructed with the idea of eliminating all trouble from broken jars or leaky cells under the severe conditions to which batteries are necessarily subjected on airplanes.

Each cell of this battery is a separate sealed unit as shown in the illustration of the Exide Automobile Starting Battery, Fig. 1. This feature is of great practical value and makes it unnecessary to cover the entire top of the battery with sealing compound. It also saves a large part of the space usually filled with sealing compound and thus reduces the weight of the

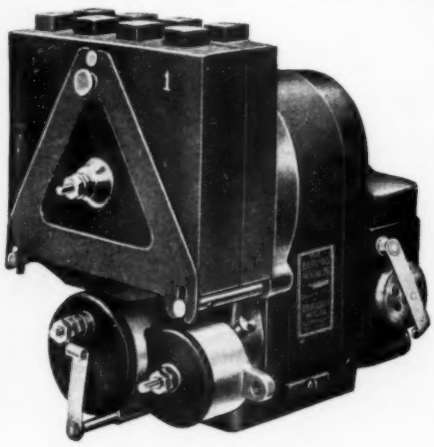
Fig. 2. Cross Section of Cell Cover Showing Filling Plug in Place

battery to a minimum. It saves time and expense when repairs are necessary.

Another important feature is the special "Exide" vent and filling plug shown in Fig. 2 which is provided with an air lock and which, automatically, limits the amount of water that can be taken into the cell to the exact amount needed to replace that lost by evaporation. This overcomes slopping and spilling and this feature, together with the special cover construction, gives a tight battery, which is particularly needed where batteries are installed on aeroplanes.

Ericsson Manufacturing Company

Berling magnetos of the D and DD types manufactured by the Ericsson Manufacturing Company, Buffalo, N. Y., have been extensively used on airplanes, particularly machines with 8-cylinder engines. Special attention has been given in designing these types of magnetos to enclose completely all high tension ground carrying apparatus thus insuring positive operation in all climatic conditions. In both of these types, neither end of the secondary winding is grounded, but each is connected to one of the two



BERLING MODEL DD MAGNETO

separate distributor blocks and one distributor finger carrying to two distributor brushes, each brush connected with the segments of its respective distributor block. This arrangement gives a hot spark at slow speeds, as in starting, and also a satisfactory spark for high engine speed.

* * *

Erie Specialty Company

Practically a complete line of screw machine products and aluminum castings for airplanes is put out by the Erie Specialty Company, Erie, Pa. The screw machine products made by this company include all types and sizes of hexagonal bolts, nuts, clevis pins, machine screws, terminals and all types of forges. In preparation for the expected boom in aeronautics, the company is increasing its

FOXBORO OIL PRESSURE GAUGE

capital stock from $100,000 to $250,000, the increase to be devoted to expanding the business along aeronautical lines. Officers of the company have been extremely active in working to bring about the standardization of small parts.

Excelsior Propeller Company

Scientifically designed aeronautical propellers are manufactured by the Excelsior Propeller Company of St. Louis, Mo. The accompanying table gives the thrust of Excelsior propellers of different diameters and pitches at rates of speed from 1,000 to 1,400 revolutions per minute.

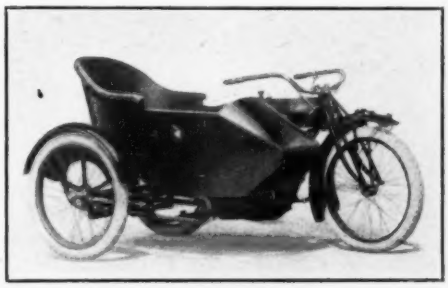
THRUST OF EXCELSIOR PROPELLERS

7′ 6″ x 5.25	1000 r.p.m.	320 lb.	8′ 0″ x 5.25	1000 r.p.m.	400 lb.	9′ x 6.00	1000 r.p.m.	520 lb.
	1100	380		1100	460		1100	580
	1200	440		1200	520		1200	640
	1300	500		1300	580		1300	700
	1400	560		1400	640		1400	760
8′ x 6.25	1000 r.p.m.	476 lb.	8′ 6″ x 5.50	1000 r.p.m.	460 lb.	9′ 6″x6.00	1000 r.p.m.	650 lb.
	1100	552		1100	520		1100	750
	1200	628		1200	580		1200	850
	1300	704		1300	640		1300	950
	1400	780		1400	700		1400	1050

L. W. Ferdinand & Company

Aeronautical supplies manufactured by L. W. Ferdinand Company, 201 South street, Boston, Mass., include glues and varnishes. The following products are of special interest to the aeronautical industry:

Waterproof liquid glue C quality.—Many prominent builders of flying boats use this glue in combination with linen between the veneer of the diagonal planking on their hulls and floats. It is not only waterproof and elastic but will waterproof and preserve the linen indefinitely. Experience has shown that when this glue is used, owing to its elasticity, the inside layer of diagonal planking will remain perfectly watertight although the outside layer be badly broken.



INDIAN MOTOCYCLE

Hollow spark glue.—This product is recommended for laminating woodwork.

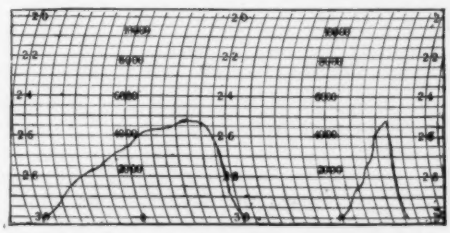
20th Century glue-cement, Marine Brand, grade A is recommended for attaching cloth to steel.

* * *

The Foxboro Company

Air speed indicators and pressure gauges for airplanes are manufactured by the Foxboro Company, Foxboro, Mass. The air speed indicator consists of a strong and accurate low-range indicating differential pressure gauge with a special calibrated nozzle. The instrument can be located anywhere on the dial board and is connected to the nozzle by means of smooth copper tubing. The indicating part of the instrument is made entirely of aluminum. The scale is calibrated to read in the units of miles per hour and the nozzle is usually located on one of the forward midwing struts pointing in the direction of motion. It is so constructed that water or moisture cannot enter.

The instruments are made in two sizes, four inches and six inches. The four-inch weighs one and a half pounds, the six-inch two and three-quarter pounds. The Foxboro Company recommends the use of the six-inch size because it is possible to construct it more substantially and to manufacture it so that the readings are more accurate. Pressure gauges to indicate oil and gasoline pressure are also manufactured by the Foxboro Company. The oil gauge is calibrated for a range of from zero to four pounds pressure. The instrument is finished with a background and the dial and indicator can easily be treated with radium luminous material.



COMPARATIVE BAROGRAPH RECORDS

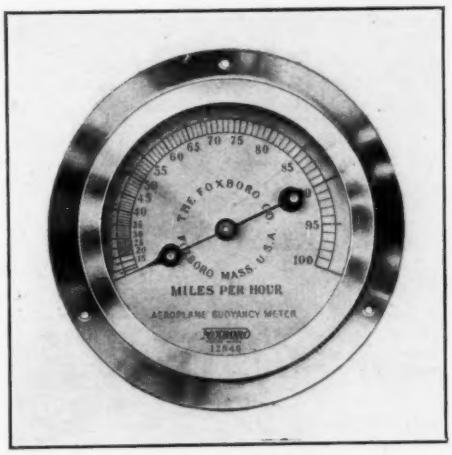
The Gastine Company

A preparation which is claimed to increase the efficiency of gasoline nearly 30 per cent and to prevent the formation of carbon in gasoline engines is marketed under the name of Gastine by the Gastine Company of Bridgeton, N. J. It is sold in tablet form and it is claimed that the use of one Gastine tablet to every gallon of gasoline produces the effect of increasing the gasoline economy and efficiency of internal combustion engines.

* * *

A. Haustetter

A rapid registering barograph with an aluminum case manufactured in five and ten thousand feet models is offered to the aeronautical trade by A. Haustetter, 308 Madison avenue, New York. The clock movements of these instruments are regulated so that the drum makes one



AIR SPEED INDICATOR

revolution per hour instead of one revolution in six hours as in former instruments. The accompanying diagram shows the difference in registration between the old and new types of barographs. The two records were made of the same flight, one with the new instrument which revolves once an hour, the other with the older instrument which revolves once every six hours.

The General Ordnance Company

The limited hitting power of rapid fire guns of the mitrailleuse type has led to the adoption of guns for airplanes firing a heavier projectile. The two factors that limit the power of the armament for airplanes are the force of the recoil and the weight of the gun. To overcome these obstacles the General Ordnance Company of Derby, Conn., is manufacturing non-recoil guns under the Davis patents. Regardless of the caliber of the gun and the weight of the projectile there is absolutely no recoil force in these guns. The only limitation in the armament for airplanes has therefore become the one of weight.

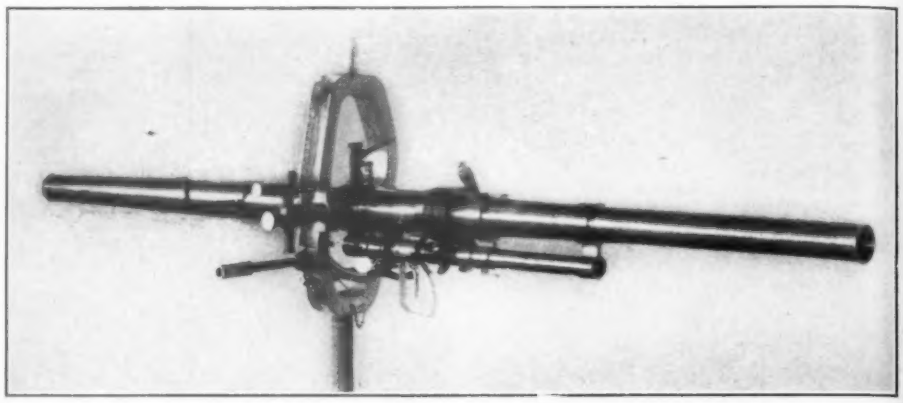
The reason that there is no recoil is that the gun, instead of having but one barrel with a closed breech, has two barrels, and the discharge of the main projectile forward also fires a charge of shot to the rear (equal in weight to the front projectile) which quickly scatters and loses its striking power.

The weight has been greatly reduced by refinements in construction. The six-pounder, Mark IV gun, for example, weighs complete only 103 pounds.

The guns are breech loaders and use fixed ammunition. The two barrels are joined together by interrupted threads. The rear barrel is kept in alignment with the front barrel by means of a rotating shaft, held in place underneath the gun in four bands.

Five hundred men are employed in the Derby, Conn., plant of the General Ordnance Company in making these guns for foreign services.

The gun illustrated is a 3-inch twelve pounder, which weighs 238.09 pounds complete. The figures are: Weight of gun, 184.25 pounds; weight of sight, 7.09 pounds; weight of gimbal mount, 46.75 pounds. The other illustration, taken at the moment of firing, shows the non-recoil feature of the gun in that it is supported on the shoulder of the man who is firing it, and has no brace in the rear, the entire recoil being taken up by the gun itself.



THE 12-POUNDER MARK III ON DOUBLE YOKE MOUNT

THE NON-RECOIL GUN AT THE MOMENT OF FIRING

* * *

Hendee Manufacturing Company

In connection with the service of airplanes in the field with the Army, one of the most useful pieces of auxiliary equipment has been found to be the motorcycle. The chief duty of these machines is to carry supplies from point to point for the aviators and also to rush mechanics to places where airplanes have been forced to descend for any cause.

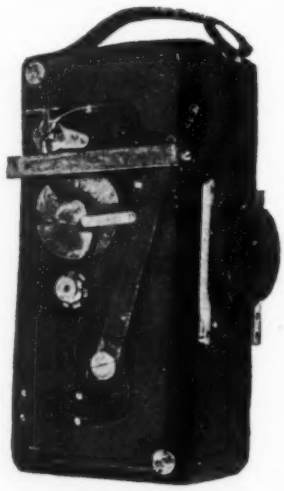
Fourteen Indian Motocycles, manufactured by the Hendee Manufacturing Company at Springfield, Mass., have recently been shipped to the Supply Officer of the Aviation Section of the Signal Corps, San Antonio, Texas, as the result of competitive bids filed with the Quartermaster, U. S. A. Some of the advantages of the motorcycle when used in connection with airplanes over any other means of transportation are its speed and strength which enables it to cover ground rapidly even where no roads exist. The machines purchased by the Quartermaster are painted olive drab and are equipped with side cars for carrying supplies of gasoline, oil and repair kits. They are lettered with Aviation Corps insignia.

INDIAN MOTOCYCLE IN USE

Herbert & Huesgen

A special airplane camera to perform the service that the barograph does in the matter of altitude and make a permanent, visible record of flight, is manufactured by Herbert & Huesgen, 18 East 42nd street, New York. The camera is of the highest quality and exceedingly simple in manipulation, using a roll film. It has a capacity for a large number of exposures and is practically automatic in action. It uses the standard perforated motion picture negative film in 50 feet lengths and has a capacity of 750 exposures at one loading.

A flexible cable with a hand grip and a self-resetting operating lever are all the outside attachments required. One pull of the flexible cable winds up the previous exposure, sets the shutter, makes the exposure, and registers the number of the photograph taken. The Multiple airplane camera is small and compact. Its dimensions are 8½ x 4½ x 2½ inches. It is constructed entirely of metal and weighs only 6 pounds. Lenses are furnished in focal lengths of from 2 to 4¾ inches, for use at altitudes from 500 to 10,000 feet. Negatives are 1 x ¾ inch. Enlargements up to 5 x 7 inches can be made with satisfactory definition, and larger pictures can be obtained by means of a projecting lantern with which the film positive is thrown on the screen for observation in the manner employed for motion picture films.



H. & H. CAMERA

This camera is in use by the United States aviators and a number have been purchased by Great Britain, France, Sweden, Russia and Japan.

* * *

Ideal Aeroplane & Supply Company

The movement for the popularization of aeronautics is being materially assisted by the manufacture of model airplanes, which is being undertaken by the Ideal Aeroplane & Supply Company, 84 West Broadway, New York. The models which are practically exact reproductions, about one-twelfth scale, of standard makes of

machines, afford opportunities for experimentation which are most interesting. The types of machines which are on sale include the Curtiss military tractor, the Curtiss flying boat, Wright, Nieuport, Taube and Bleriot. The machines are supplied dissembled with complete instructions for assembling.

* * *

The Janney-Steinmetz Company

THE STEINMETZ BOMB

The Janney-Steinmetz Company, Philadelphia, Pa., announce for 1917 high pressure hydrogen cylinders for balloon equipment as well as for oxygen and other high pressure gases. A full line of forged bronze high pressure valves for control of pressure in the containers is offered to the public as well as Jasco seamless non-leakable gasolene tanks. An airplane bomb for use in aerial warfare is also being developed by the company. This bomb, shown in the illustration, is patented by Joseph A. Steinmetz and has many interesting features.

* * *

Keasby & Mattison

Airplane and airship sheds have been covered with asbestos sheathings made by Keasby & Mattison of Ambler, Pa., for many years. The product of this company was used in constructing the sheds at Baden-Oos, Germany, as well as at Frankfort for the Schwaben and other lighter-than-aircraft manufactured by Count von Zeppelin before the war. Steel frame construction was used in building these hangars and they were covered with asbestos building lumber. A model of one of the German Zeppelin hangars built by Keasby & Mattison is shown in the accompanying cut.

K. & M. ZEPPELIN HANGAR MODEL

The product of the company has been approved by the United States Navy and is in use at the Pensacola Aeronautical Station.

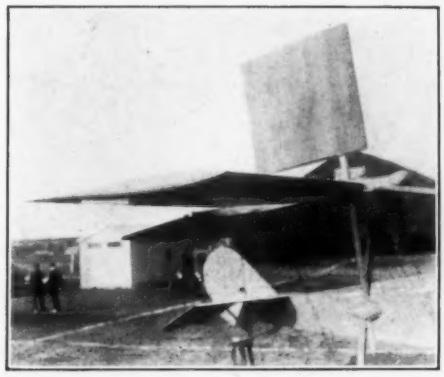
* * *

Klaxon Company

For signalling between airplanes and the ground, sound systems are being employed successfully already and the Klaxon Company, of Newark, N. J., is experimenting with a special aluminum horn of good aerodynamic qualities and light weight for airplane use. The company, however, is not in a position to make an announcement or give out any information as to the development of this instrument for aeronautical purposes.

Capt. James V. Martin

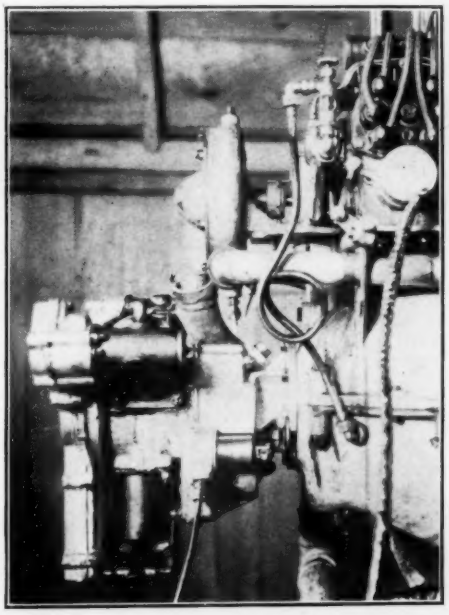
An automatic stabilizer, attached to the extremities of the wings of an airplane, is shown in the accompanying photograph.



MARTIN AERODYNAMIC STABILIZER

It is claimed to insure automatic lateral balance entirely independent of ailerons and is offered to the public by Captain James V. Martin. A test of this stabilizer on a Curtis JN 4 army tractor has been carried out at Mineola, L. I., one of the tests including a flight from Mineola to Princeton, N. J., with the ailerons locked and sealed and the aileron wires removed. Flights were made by Captain Martin and Aviator Allan Adams. The official claims made for his stabilizer by Captain Martin after flights in the presence of Captain J. E. Carberry and Lieutenants Kilner and Rader, U. S. A., have been transmitted to the Aviation Section of the Signal Corps, by courtesy of Captain Carberry, and are as follows:

1. The airplane in straight directional flight, whether progressing in a horizontal plane or ascending or descending, is maintained at all times in the lateral horizontal.
   a. Gusts are more quickly corrected by the stabilizer than is possible when the pilot controls.
   b. Any tendency to roll is imperceptible.
2. The airplane is exceedingly sensitive to its vertical rudder and takes and holds a definite bank for every angle of the rudder.
3. The Curtiss ailerons placed one hard up and the other hard down will not roll the airplane more than four degrees and will not keep the wing down more than two seconds.
4. The Curtiss ailerons will not take the airplane out of a bank even on a very wide turn.
5. The airplane glides and spirals perfectly with engine cut off.
6. The stabilizers are at least four times as powerful as the Curtiss ailerons.
7. The airplane appears just as speedy and controllable as it was before the stabilizers were installed.
8. The airplane cannot be made to side-slip or skid.
9. The device worked excellently in a 22-mile wind.
10. Many successful flights were made after the Curtiss ailerons wires had been entirely removed from the machine.

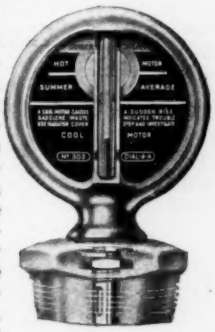


MOTOR COMPRESSOR STARTER

* * *

Motometer Company

The temperature of aviation motors is indicated by two models of instruments manufactured by the Motometer Company, of Long Island City, N. Y., which can be applied to airplanes in three different manners. The first instrument is an adaptation of the one used in the automobile industry, but instead of being manufactured in the round form, is made of a small light tube offering minimum head resistance. The instrument is adapted to the radiator cap in the same manner as an automobile moto-meter. It takes its readings from the temperature of the air over the water.

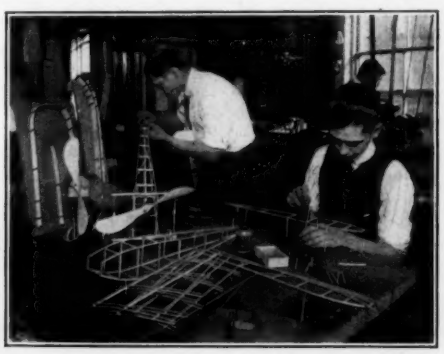


The second form of instrument is substantially the same as the first, but is so arranged as to be connected directly to the outlet from the engine to the radiator, thus recording the actual temperature of the water. The Motometer Company is also manufacturing a dashboard moto-meter which can be connected by means of a flexible tube directly with the water outlet.

* * *

Motor Compressor Company

An efficient self-starter for aviation engines is manufactured by the Motor Compressor Company, 52 Dickerson street, Newark, N. J. The installation of the model D starting device on a Hall-Scott



AIRPLANE TOYS

engine is shown in the accompanying photograph. At a recent government test, Lynn Reynolds, U. S. Inspector of airplanes and airplane engines, reported that a thorough try-out was made with the model D under his supervision under a Hall-Scott A-5 125 horsepower engine which gave very good results.

Some of the points in favor of the starting device are that it is light and compact, is warmed very easily, has an efficiency well over 90 per cent, its parts show little wear even after long service and the total weight is very low. Model C starter is of a four-cylinder type, two cylinders each arranged 90 degrees apart. Model D is of a three-cylinder type, the

cylinders being arranged radially at an angle of 120 degrees. The model C starter weighs 39 pounds and complete with all fittings, tank, control, valve, gauge, tubing, etc., weighs 70 lbs. The model D starter weighs 35 pounds and complete with all fittings, etc., weighs 58 pounds. For twin installation, the weight per starter is materially reduced. Model C with a starter for each engine weighs complete 110 pounds and model D 96 pounds.

* * *

The Norma Company of America

The interest of the aviation world in bearings lies in their almost universal use in the magnetos which are known for their dependable service. An airplane is no better, in the last analysis, than its engine; its engine is no better than its magneto; its magneto is no better than its bearings. In the seeking for safety and dependability, it must be significant that Norma bearings are identified with magnetos of proved dependability.

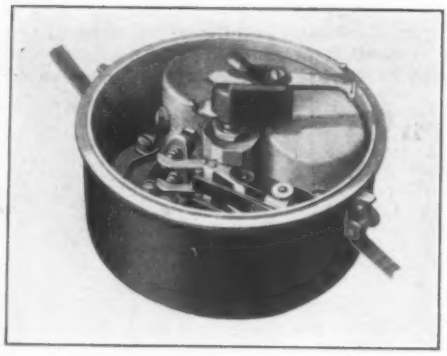
A Norma Bearing

The Norma bearing is pre-eminently a high-speed bearing, owing its superlative speed qualities to several distinctive features among which are: open type, separable construction; rigid mounting of both races; very light ball cage; polar guiding of balls; extremely high precision; utmost refinement of finish; selected materials specially treated. So perfectly has Norma speedability met the conditions that Norma bearings are today the standards in practically all of the high-grade magnetos and lighting generators made in America.

Another interesting application of this bearing is in the Sperry Gyroscopic compass. At the two bearings in this sensitive mechanism where the essentials are rigidity and strength combined with utmost freedom of movement, Norma bearings are used because their peculiar design, rigid mounting and extreme precision assure the maximum of anti-friction qualities.

Norma bearings are manufactured by the Norma Company of America, 1790 Broadway, New York. Originally an imported product, the situation abroad compelled the American company to enlarge its New York factory to meet its orders. Plans are completed for the first unit of a complete new factory.

The Norma line is not limited to small magneto bearings. It includes also larger ball bearings in all the internationally standardized sizes, as well as roller bearings, thrust bearings, and combined radial and thrust bearings. All are distinguished by the characteristic Norma precision, silence and serviceability.



Remy 12-Cylinder Distributor

Radium Chemical Company

The Aviation Section of the Signal Corps of the United States Army has recognized the importance of radium luminous compounds for aviators' instruments in its specification No. 1002, in which radium compound No. 6 manufactured by the Radium Chemical Company, Pittsburgh, Pa., is specified for all dashboard instruments including barometers, clocks, compasses, speed indicators, clinometers, etc. The Radium Chemical Company manufactures radium luminous compounds in ten different grades.

* * *

Radium Luminous Material Corp.

Allied airplanes are now fully equipped with self-illuminated instruments. The indicators and dials are painted with radium compound which makes them shine in the dark without previous exposure to light. About two years ago the Radium Luminous Material Corporation, 53 Liberty Street, New York, became the American pioneer of this new industry. Since the publication of "Efficient Instrument Illumination for Military Night Fliers" which appeared in the October 1st issue of Aviation and Aeronautical Engineering, many new uses for the products of the Radium Luminous Material Corporation have been found, and the standardization of them in Washington has been effected.

The Chelsea Clock Company, the Sperry Gyroscope Company, Waltham Watch Company, Messrs. Robert H. Ingersoll & Brother, E. S. Ritchie & Son, and Keuffel & Esser Company, are now using the products of the Radium Luminous Material Corporation, for illuminating their instruments.

Remy Ignition Coil

Remy Electric Company

Electrical Equipment for airplanes, including magnetos, starting and lighting systems and ignition distributors are manufactured by the Remy Electric Company, Anderson, Ind. The magnetos, Models P and 32, are of the shuttle armature type producing a dynamic spark of great intensity. The Model P is a single distributor instrument for single point ignition. The Model 32 is a double magneto, single, distributor instrument, and dual ignition is obtained on the same set of spark plugs.

The Model SL, combined starting motor and generator, employs two separate armatures and two separate fields. A new type of the Remy ignition distributor for 12 cylinder engines is announced for the first time in 1917. It can be used only in connection with a generator system. Greater flexibility then can be obtained and magneto ignition is claimed for the ignition distributor and coil. This system delivers a spark of practically constant intensity regardless of the engine speed. Its reliability and durability are emphasized by the small number of moving parts and the high grade of materials.

* * *

Robinson-Roders Company

Life-preservers especially designed for aviators are manufactured by the Robinson-Roders Company, Newark, N. J. The preserver which is known as the Universal Ilanasilk aviator's life-preserver permits full use of the arms for handling the controls. It is a modification of the preserver approved by the U. S. steamboat inspectors for use on all vessels. The preserver is made of the best quality Java fiber directly imported by the Robinson-Roders Company giving maximum flotation.

Ilanasilk Life-Preserver

* * *

John A. Roebling's Sons Company

Practically all airplanes of American manufacture use Roebling wire, strand or cord. This wire is manufactured by John A. Roebling's Sons Company, Trenton, N. J.

Four types and many grades of each type are announced for 1917. Roebling No. 19 wire consists of nineteen fine wires stranded together. The grade that has for its diameter 1/32 of an inch, is made of seven wires. This strand is made for stays.

Roebling 19-Wire

Roebling tinned aviator cord is composed of seven strands of nineteen wires each. It is made in grades from 1/8 of an inch in diameter to 3/8 of an inch in diameter. Roebling extra flexible aviator cord is composed of six strands of seven galvanized wires each and a cotton center. On account of its flexibility this grade is used for steering gears. Roebling flexible aviator cord is also used for control wires. It is made with seven strands of seven galvanized wires each.

Hutchison Scott Company

In a recent discussion of the problems confronting the airplane industry, Lieutenant-Colonel George O. Squier, Aviation Section, Signal Sorps, U. S. A., stated that it was desirable to develop an airplane wing covering to be manufactured in this country. Such a material is Olax airplane cloth, manufactured by the Hutchison Scott Company, 17 Battery Place, New York. This is manufactured from a high grade long fiber cotton specially woven into sheeting 36 inches wide; is waterproofed by the Olax process, is not subject to spontaneous combustion even at temperatures above 230 degrees Fahrenheit. The Hutchison Scott Company also manufacture Olax No. 565 duplex cloth for heavy service dirigible work.

* * *

Searchlight Company

WELDER

Equipment for oxy-acetylene welding is manufactured by the Searchlight Company, 415 Karpen Building, Chicago, Ill. This equipment makes use of the fact that when oxygen and acetylene are combined in a torch, a temperature of 6300 degrees Fahrenheit is produced. This intense heat is sufficient to fuse and weld the edges of two pieces of metal together or to cut iron, steel, copper, brass or aluminum as easily as wood is cut with a saw.

* * *

The S. K. F. Ball Bearing Company

The success with which ball bearings are being used in airplane construction is due largely to the fact that, when correctly designed and manufactured, they are absolutely reliable. A radial bearing of the type manufactured by the S. K. F. Ball Bearing Company, of Hartford, Conn., consists of an outer ball race, an inner race, two rows of balls and a ball retainer or spacer. The balls and races are accurately made of highly-tempered Swedish crucible steel. The ball spacer, of pressed steel, or bronze (depending upon the type of bearing in which it is used), is made in one piece: there are no screws or rivets to work loose and interfere with the proper action of the bearing.

In the inner race of the bearing, definite paths for the balls are formed by grinding two grooves in the outer surface. No definite path is provided for the balls in the outer race; the surface on which they roll is ground so as to form part of the sphere, the center of which always lies on the axis of the shaft. It will be seen that the bearing is really an adaptation of the "ball and socket" principle; although the shaft may deflect, the strain on the bearing is not increased. This cannot be said of any other type of bearing.

Automatically aligning bearings are invaluable in the airplane, because of the necessarily flexible nature of the construction of these machines. Airplanes are frequently subjected to severe shocks and stresses, which tend to distort the frame. This distortion throws the bearings out of alignment, possibly even causing the moving shafts to spring slightly. The result of this disalignment in ordinary bearings is to cause cramping and binding; but in S. K. F. ball bearings the self-aligning feature automatically adjusts itself to all movements of the shaft.

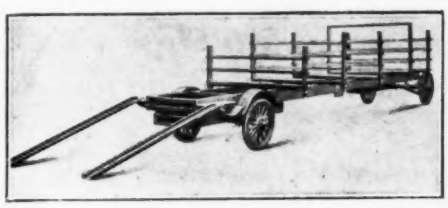
Next in importance to reliability comes lightness; that is, the weight per horsepower should be as low as possible. A ball bearing is much more compact and much lighter than the plain bearing; in addition, it saves at least three-fourths of the power usually wasted by the babbitt or bronze bearing. Thus, at the same time that the weight and size of the machine are reduced, the amount of available power is increased.

For use in propeller shafts a double thrust bearing is provided. This bearing is capable of accepting thrust in two directions, and, like the radial bearing, is self-aligning.

* * *

The Sechler & Company

The transportation of airplanes from place to place not under their own power is a problem which the use of trail hauling is expected to do much to solve. On January 19 the United States Army approved the airplane carrier built by The



TRAILMOBILE AIRPLANE CARRIER

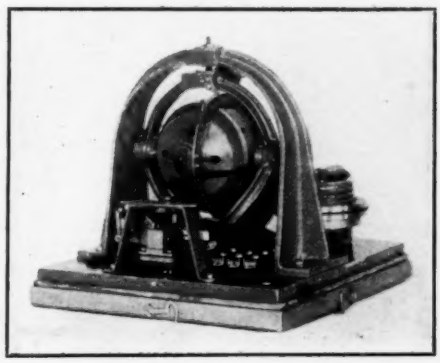
Sechler & Company, 538 East 5th Street, Cincinnati, Ohio, for service in connection with the Aviation Section of the Signal Corps. By the use of this machine dissembled airplanes can be transported from place to place with minimum difficulty and disabled planes can be cared for. The skids in the rear of the new airplane ambulance are removable and the plane can be run up into the carrier on its own wheels. The cradles are padded and the wings can be placed in a special wing carrier on the same vehicle with the body.

The Sperry Gyroscope Company

The azimuth stabilizer, announced by the Sperry Gyroscope Company, of Manhattan Bridge Plaza, Brooklyn, N. Y., is an instrument used with the servo-motor for the purpose of automatically steering an airplane over a pre-determined straight course.

The Sperry azimuth stabilizer relieves the pilot of all strain in steering. This is particularly advantageous in making long cross-country flights, in bomb dropping and target sighting, when it is most essential that a machine hold a straight course.

The principle of the azimuth stabilizer is that of the gyroscope. The latter is



AZIMUTH STABILIZER

mounted in a gimbal ring, so that any movement of the airplane in azimuth causes an electrical contact to be made which operates a magnetic clutch in the servo-motor, thereby bringing the machine back to its original course.

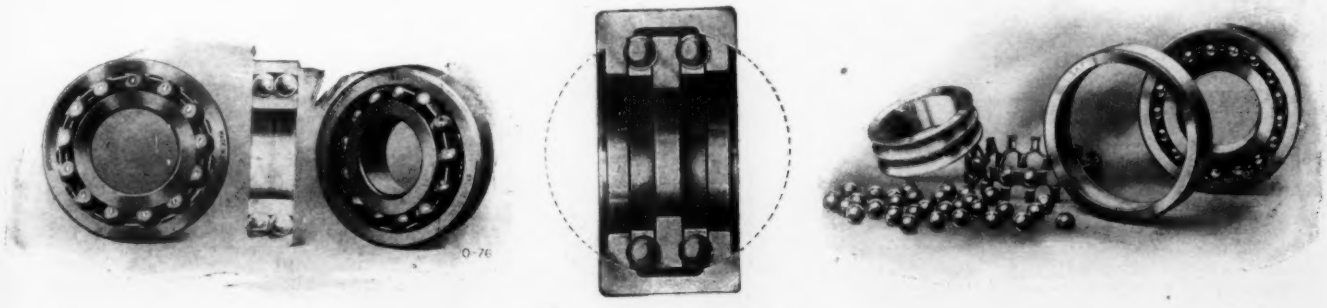
Since these two instruments operate almost simultaneously, there is no appreciable lag. Any variation exceeding one quarter of a degree from the course is immediately corrected through the medium of the controlling surfaces.

The servo-motor supplied with the Sperry azimuth stabilizer is a device embodying reduction gearing and magnetic clutches. This is connected directly to the rudder cables. The power necessary for operating the servo-motor is supplied by a fan mounted in the air-stream. The electrical power required to operate these instruments is derived from a fan-operated generator, also mounted in the air-stream.

Both of these devices can be immediately released from the controls. It is necessary only for the pilot to place his foot on the rudder bar to resume manual control.

A NEW COMPASS FOR AVIATORS

For plotting a course after landing in an unfamiliar locality, as well as for general air service, the Sperry Gyroscope Company is manufacturing an aviators' pocket compass, accuracy of which has



THREE S. K. F. BEARINGS

been increased by suspending the dial in a liquid and which can be read at night by its own light.

For uses in a Military Aviation Corps this compass is supplied to the observer, who usually has it secured by means of a strap to his leg above the knee, or to his wrist.

Knowledge of navigation is not essential for laying a course with this compass. The first step is to set the instrument upon the chart at the spot indicating the user's location. The zero mounting of the outer ring, in line with the arrow point on the glass crystal, should point toward the North or top of the map.

AVIATOR'S COMPASS

Any course desired may be found by elevating to an angle of about 45 degrees the arm or metal attached to the outer ring and then sighting over its top and the niche in the magnifying glass bezel ring to a pin stuck in the chart at the point of destination. One important advantage of this compass is that parallel rules for sighting are unnecessary and may be dispensed with.

In order to travel from any location to a particular destination it is essential to apply the magnetic variation. To do this it is merely necessary to move the lubber's line, indicated by a white line and arrow, painted on the crystal, to the point of destination. Then this line becomes the lubber's line to be followed in actual travel.

This compass, measuring an inch and a quarter thick and two and three-quarter inches in diameter, contains no steel except that in the magnet.

To increase the accuracy of this compass, the card is mounted in a mixture of alcohol and distilled water, thus rendering the magnetic float more buoyant and sensitive. The markings are readable at

NEW SPERRY COMPASS

night in the light from the radium dial, which is graduated every 5 degrees and numbered every 20 degrees. The last zero is omitted in all numbers to avoid crowding.

* * *

So-Luminum Manufacturing Company

A welding compound for broken aluminum parts is manufactured by the So-Luminum Manufacturing Company, 1790 Broadway, New York. It is claimed that So-Luminum does the work with aluminum which acetylene welding could never accomplish. It is stronger and harder than aluminum itself and by its use, aluminum parts can be repaired so that they are stronger than before they were broken. It has great ductility, holds its color and is simple to use. No tools are required in handling it. It is used by the United States Army and Navy and many automobile companies.

* * *

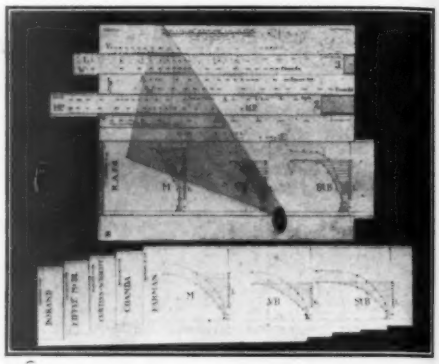
Standard Aeronautical Company

A mathematical calculator of great value to airplane designers is manufactured by the Standard Aeronautical Company, of Chicago, Ill. It is a triple-slide rule especially designed for making airplane calculations. It is suited to make calculations for the following wings: Eiffel 32, Eiffel 35, Eiffel 38, RAF6, Furnam wing and Curtiss right wing. The extra slides of any laboratory testing wing curve can be furnished on special order.

* * *

Vacuum Oil Company

Lubricating oil for gasolene engines of all types is sold by the Vacuum Oil Company, 61 Broadway, New York. Eight different grades of oil and lubricant are marketed, and one of these grades is adapted for use in every form of aviation engine.



AIRPLANE CALCULATOR

* * *

Waltham Watch Company

High grade clocks and watches for aviators are being developed by the Waltham Watch Company, Waltham, Mass., and this company expects shortly to announce wrist watches, pocket time pieces and chronometer instruments specially devised for high altitudes, particularly for use in airplanes. Waltham timepieces for aviators will be specially designed and adjusted to meet the particular and unusual conditions of aviation.

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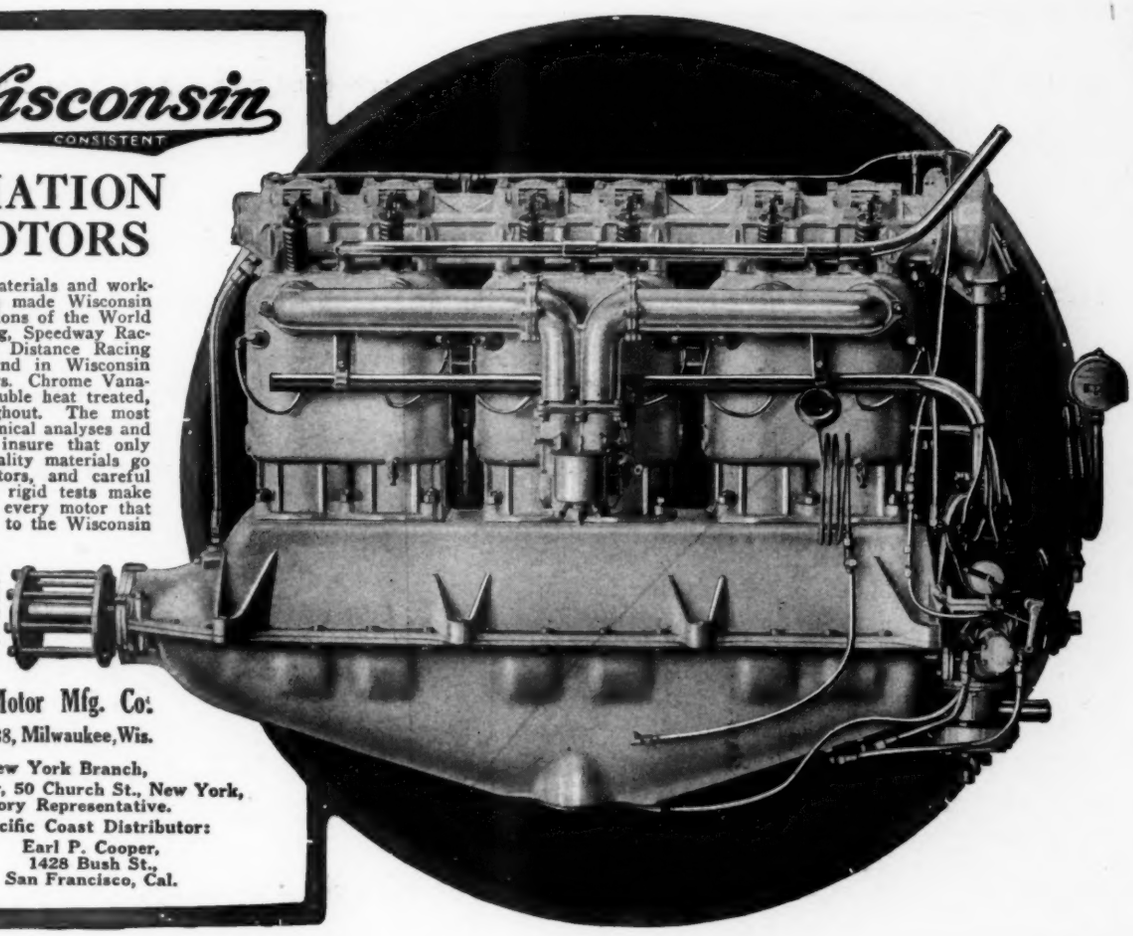

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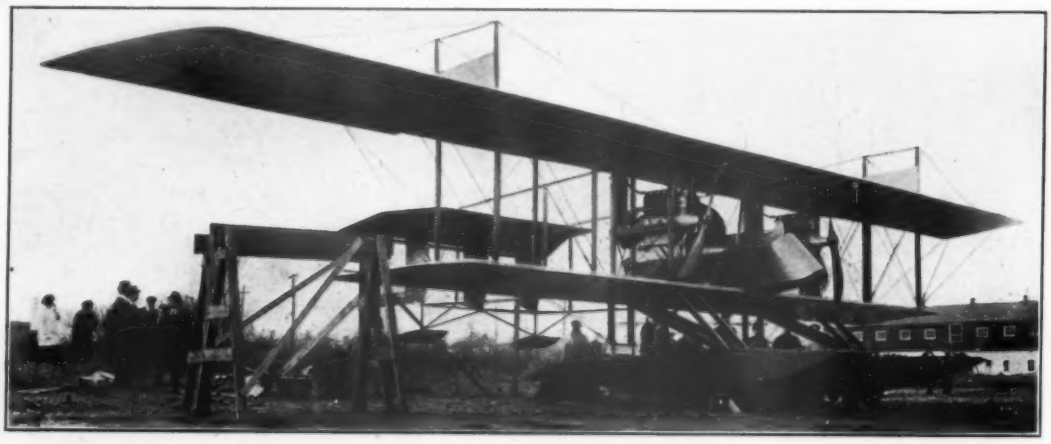

The above Seaplane, manufactured by us, equipped with Twin-90-H.P. Aeromarine Engines, and flown by Aviator W. L. Bonney, rose from the water within 50 feet.

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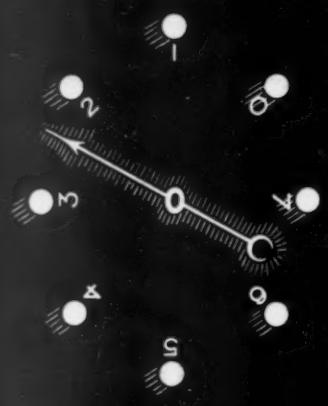

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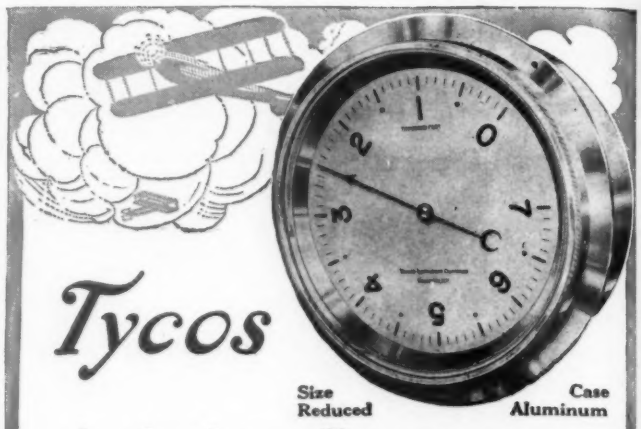

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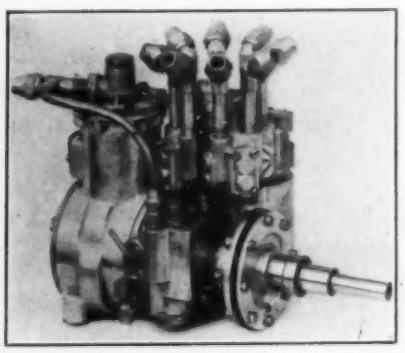

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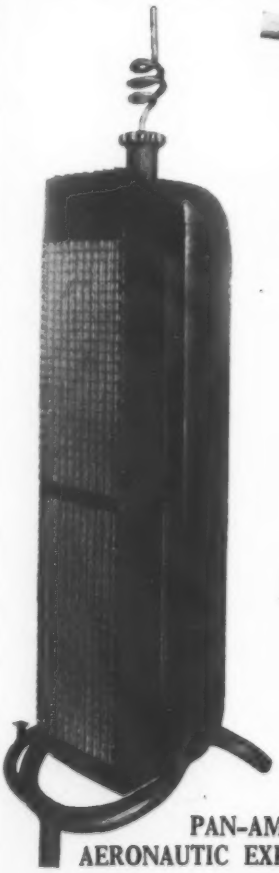

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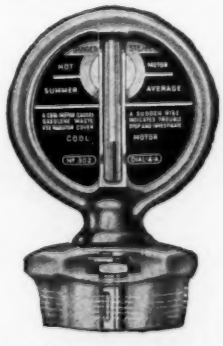

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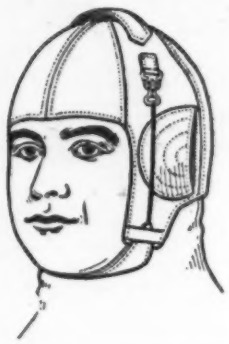

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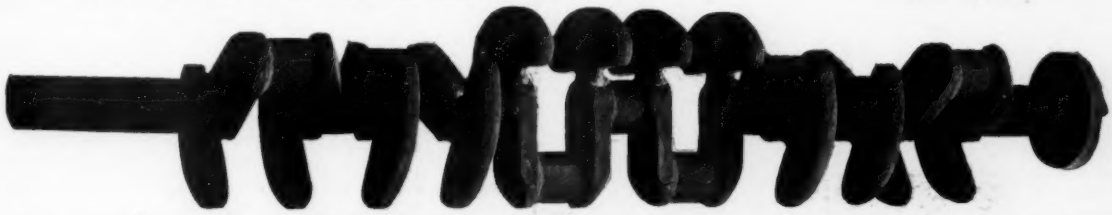

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Main Supporting Surface: 245 sq. ft.
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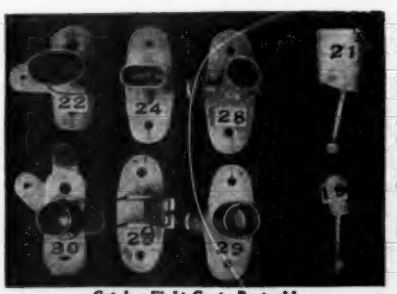

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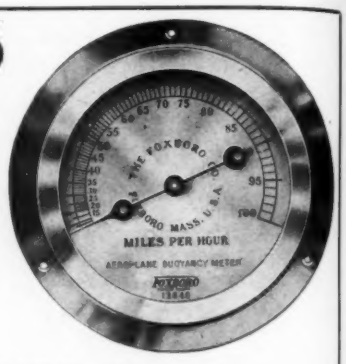

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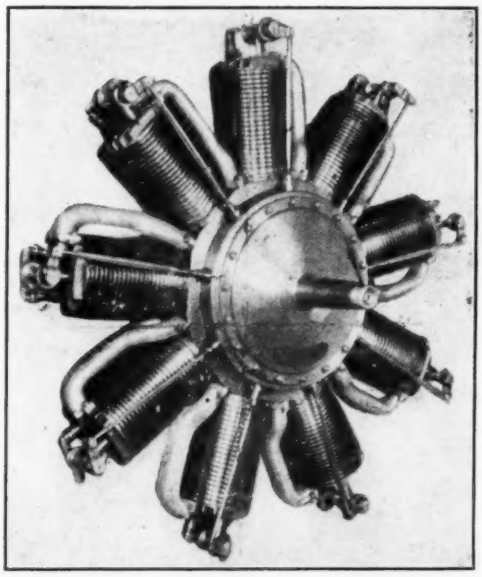

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